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Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

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Semi-Annual Status Report, 15 Jul. 1963-15 Jan. 1964 [INTERDISCIPLINARY STUDIES OF THE EFFECTS OF HIGH ENERGY PROTONS ON BIOLOGIC SYSTEMS]
Raymond N. Kjellberg [17 Feb. 1964] 40 p
(NASA Grant NsG-262-63)
(NASA CR-53780) OTS: $3.60 ph

Investigations using a 160-Mev synchrocyclotron cover detailed mapping of dose distributions from proton beams of various diameters, gamma ray absorption coefficient measurements in various types of human tissue, 24 to 110 Mev proton irradiation of germanium, biologic effects of proton radiation, biologic protection against proton radiation, and in-phantom dosimetry. R.L.K.

N64-19359 American Inst. of Aeronautics and Astronautics, New York, N.Y.
AIAA FIFTH ANNUAL STRUCTURES AND MATERIALS CONFERENCE
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39. VIBRATION CONTROL IN RELAY DESIGN R. L. Lowery, B. C. Riddle, and G. C. Stone 23 p refs (See N64-19540 12-23)

40. RELAY DEFINITIONS AND TERMINOLOGY E. U. Thomas (Grumman Aircraft Eng. Corp.) 15 p refs (See N64-19541 12-09)

41. APPROXIMATE POWER-TEMPERATURE RELATIONSHIPS FOR COPPER WIRE COILS B. Giese (ITT Kellogg) 12 p refs (See N64-19542 12-09)

N64-19597* National Aeronautics and Space Administration, Washington, D.C.

THE IMPACT OF NASA'S ACTIVITIES ON EDUCATION

Hugh L. Dryden [1964] 18 p Presented before the Natl. U. Extension Assoc., Washington, 26 Apr. 1964

(NASA TM X-51625) OTS: $1.60 ph

The impact of the space age on our civilization is discussed. Emphasis is placed on the challenge to educators of space exploration. The impact of NASA's activities on education, and the educational programs that NASA sponsors are also discussed. R.T.K.

N64-19676 Advisory Group for Aeronautical Research and Development, Paris (France)

PROPAGATION OF RADIO WAVES AT FREQUENCIES BELOW 300 KC/S

W. T. Blackband, ed. (RAE) Oxford, N.Y., Pergamon, 1964 490 p refs Proc. of the 7th Meeting of the AGARD Ionospheric Res. Comm., Munich, 1962

(AGARDograph 74) Pergamon Press and Mac Millan Co.: £ 7

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N64-19782 Joint Publications Research Service, Washington, D.C.

STUDY OF DNA MOLECULE FLEXIBILITY AND CONTINUOUS MODELS OF EXCITABLE MEDIA

O. B. Ptitsyn, B. A. Federov, and I. P. Lukashevich 20 Apr. 1964 23 p refs Transl. into ENGLISH of 2 articles from Biofizika (Moscow), v. 8, no. 6, 1963 p 659–663, 715–721 (JPRS-24256; OTS-64-31102) OTS: $0.75

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2. INVESTIGATION OF CONTINUOUS MODELS OF CONTROL SYSTEMS ON ELECTRONIC COMPUTER I. P. Lukashevich p 11–20 refs (See N64-19784 12-20)

N64-19800 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Hamburg (W. Germany)

THE DEMAND OF PROFESSIONAL PILOTS WITHIN THE GERMAN FEDERAL REPUBLIC [DER BERUFSFLUGZEUGFUHRERBEDARF IN DER BUNDESREPUBLIK DEUTSCHLAND]

K. Steininger Porz-Wahn, DVL, Feb. 1964 49 p refs In GERMAN; ENGLISH Summary

(DVL-345) Available from Vereinigte Universitäts- u. Fachbuchhandlungen, Köln, R.-Wagner Str. 1, W. Germany

By interviewing a representative cross section of aircraft owners within the Federal Republic of Germany, information on professional pilots was obtained according to age, license, and kind of operation. The actual increase in licenses and employees in 1962, as well as the anticipated increase in 1963, shows the general trend of demand. The best way to fill this demand from the available group of applicants is discussed. Author

N64-19826 Argonne National Lab., Ill.

AMU-ANL CONFERENCE ON DIRECT ENERGY CONVERSION, NOVEMBER 4-5, 1963

Dec. 1963 186 p refs Held at Argonne, Ill., in cooperation with Assoc. Midwest U.

(Contract W-31-109-ENG-38)

(ANL-6802)

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N64-19889* National Aeronautics and Space Administration, Washington, D.C.

A SELECTED LISTING OF NASA SCIENTIFIC AND TECHNICAL REPORTS FOR 1963

1964 245 p refs

(NASA SP-7005) OTS: $3.50

Abstracts, a subject index, a corporate source index, and a personal author index are given for selected NASA scientific and technical reports. The abstracts presented are grouped and listed under 34 categories. The subject index is characterized by terms that identify the particular area of study. Appearing under these terms are the notation of content and the accession number for each report. The notation of content explains briefly what the report contains, and the accession number is assigned by NASA. In the corporate source index, the reports are identified by the corporate source, under which appears the notation of content and the accession number. In the personal author index, the reports are identified by the names of the authors, followed by the notations of content and the accession numbers. Finally, the reports are listed in a report/accession number index and an accession/report number index. C.L.W.

N64-19907 RAND Corp., Santa Monica, Calif.

SOME RAMBLINGS AND MUSINGS ON TACTICAL RECONNAISSANCE

Amrom H. Katz Mar. 1963 10 p ref

In this paper, it is suggested that what is needed, above all, in any future limited war is improvisation on the spot. Recommended as prehostility measures are: (1) development of a strong visual-reconnaissance capability for both reconnaissance and strike attack; (2) developing skills of improvisation with respect to organization and use of equipment; and (3) the development of command structure and intelligence setups having enough flexibility to permit exploiting improvised reconnaissance techniques. In order to practice, develop, and, hopefully, invent the needed skills, the use of tactical-reconnaissance maneuver systems and of ongoing games is advised, and a modification or enlargement of a real three-dimensional exercise, an experiment called Hiders–Finders, is proposed. Real war games, as a source of actual material for experimenting under field conditions, are suggested. R.L.K.

N64-19961 Library of Congress, Washington, D.C. Aerospace Information Div.

FUTURE TRENDS IN SOVIET SCIENCE AND TECHNOLOGY. REVIEW OF SOVIET LITERATURE

23 Jan. 1964 308 p

(AID-P-64-6; AD-435019) OTS: $19.75 ph

The materials compiled as indicative of Soviet projections into the future fall generally into these categories: (1) broad discussions of the whole field of science, usually at a very popular level and usually by the "elder statesmen" of Soviet science; (2) reviews of the status of a specific field by an authoritative representative; (3) reports of institutional activity or conference proceedings, which, while delineating present lines of research, recommend their continuance in the future or suggest other approaches; (4) announcements of innovation, that is, new institutions, new instruments, or new concepts, with direct implications for the future conduct of research; and (5) information on personnel, organization, and administration indicating overall scientific priorities. Author

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-19322* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A STUDY OF THE STABILITY AND LOCATION OF THE CENTER OF PRESSURE ON SHARP, RIGHT CIRCULAR CONES AT HYPERSONIC SPEEDS

Jim A. Penland Washington, NASA, May 1964 36 p refs

(NASA TN D-2283) OTS: $1.00

Analysis of experimental data obtained on various sharp, right circular cone models at a Mach number of 6.8 and a Reynolds number of 0.22×10^6 per inch indicates that the Newtonian theory gives good predictions of the longitudinal stability and performance parameters through a 30° angle-of-attack range for cones with semivertex angles less than 40°. The location of the center of pressure was found to be fixed for a given cone angle and independent of angle-of-attack change. A decrease in Reynolds number by a factor of 5 made no change in the longitudinal characteristics of a 5° semivertex cone except an increase of drag due to skin friction. The calculated longitudinal characteristics are presented for cones with semivertex angles of 2.5° to 50° in Newtonian flow for angles-of-attack from 0° to 180°, with both base area and planform area reference. Author

N64-19478* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

STATIC STABILITY CHARACTERISTICS OF BLUNT LOW-FINENESS-RATIO BODIES OF REVOLUTION AT A MACH NUMBER OF 24.5 IN HELIUM

Robert D. Witcofski and William C. Woods Washington, NASA, May 1964 49 p refs

(NASA TN D-2282) OTS: $1.25

Two classes of low-fineness-ratio bodies were investigated. The angle-of-attack range covered was from 0° to 20°. Reynolds number, based on maximum body diameter, varied from 0.26×10^6 to 0.45×10^6. Curves faired through the summary plots gave access to the aerodynamic characteristics of bodies having any variation of shape within a given class. Comparison of the data was made with results obtained by modified Newtonian theory. Author

N64-19632 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamics Lab.

EXPERIMENTAL STUDIES OF HIGH TEMPERATURE HYPERSONIC DIFFUSERS

Richard T. Smith Feb. 1964 57 p refs

(FDL-TDR-64-4; AD-435816)

The effect of various diffuser configurations and blunted-cone models on tunnel blockage and pressure recovery of a high-temperature hypersonic-gasdynamics facility is presented. These studies were conducted in the RTD One-Megawatt Prototype Electrogasdynamic Facility operating continuously with dry air. All data were obtained with frozen flow at Mach number 7.6, a stagnation enthalpy of 3,000 Btu/lb, and an arc-chamber pressure of 7 atm. To determine the effects of extreme air temperatures, the total enthalpy was varied to 6,000 Btu/lb with one diffuser configuration. Author

N64-19668 Cincinnati U., Ohio
THE WEAK INTERACTION THEORY FOR HYPERSONIC FLOW OVER CONES [Technical Documentary Report, Jul. 1962-Mar. 1963]
Werner Hoelmer and Maido Saarlas Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Mar. 1964 58 p refs
(Contract AF 33(616)-8453)
(ARL-64-37; AD-437799)

The weak interaction effect on cone surface pressures was measured and found to be in good agreement with theory. Correlation was established at a nominal Mach number of 14 with the value of the hypersonic interaction parameter, based on free-stream conditions, ranging from 4 to 20. By using an inverse approach, the cumbersome iteration method suggested by Talbot has been simplified to a one-step calculation. The results are shown to be nearly identical with Probstein's first-order theory for values of the hypersonic interaction parameter less than 20. Computer solutions were found for 5°, 10°, 15°, and 20° semivertex angle, sharp-nosed cones at free-stream Mach numbers between 5 and 20, and wall-to-adiabatic-wall temperature ratios between 0.1 and 1. Author

N64-19721* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL STUDY OF THE PRESSURE AND HEAT-TRANSFER DISTRIBUTION ON A 70° SWEEP SLAB DELTA WING IN HYPERSONIC FLOW
Mitchel H. Bertram and Philip E. Everhart Washington, NASA, Dec. 1963 126 p refs
(NASA TR R-153) OTS: $2.75

Results are presented for a study of the pressure and heat-transfer distributions and force characteristics of slab delta wings of 70° sweep at Mach numbers 6.8 and 9.6 in air and 18 in helium. The wings had cylindrical leading edges and were tested with two different noses. One was sharp in plan view, and the other was a tangent sphere with the same diameter as the cylindrical leading edge. Simple approaches to predicting the heat transfer are shown to be successful if the flow pattern peculiar to the angle-of-attack range under consideration is taken into account. Author

N64-19762 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TURBULENT BOUNDARY LAYER ON AN AXISYMMETRICAL BODY RAPIDLY REVOLVING IN AN AXIAL FLOW
L. A. Dorfman 10 Feb. 1964 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1962 p 18–22
(FTD-TT-63-1137/1+2; AD-433581)

The problem of the axial flow around an axisymmetrical body revolving in the axial flow of a viscous fluid is discussed. This problem has significance in the design of the rotors of turbomachines, screws or propellers, flights of revolving missiles, etc. A discussion is presented of an approximation method of computation, which takes into account the influence of the "fanlike" effect of the revolution on the flow in the boundary layer of the revolving axisymmetrical body in the axial flow. R.T.K.

N64-19764 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINING THE AERODYNAMIC FORCES ACTING ON BODIES WITH FRONTAL DISRUPTION ZONE IN HYPERSONIC FLOWS
V. G. Bukovshin and G. I. Taganov 30 Jan. 1964 12 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 3, no. 2, 1963 p 215–221
(FTD-TT-63-1206/1+2; AD-433483)

It is shown that, with supplementary assumptions, Newton's method can be used for determining the aerodynamic forces acting on a random body around which flows a hypersonic stream forming a disruption zone for a given configuration. Presented are the computation for the aerodynamic coefficients of a sphere with a needle and a cone with a needle and the computation for the aperture angle of a fluid cone (boundary of disruption zone) and for the angle of incidence of the body on the aerodynamic forces. Author

N64-19862 McGill U., Montreal (Canada) Mechanical Engineering Research Lab.
EXPERIMENTAL INVESTIGATION OF A 5% THICK AEROFOIL WITH SHARP LEADING AND TRAILING EDGES, AND BLOWING APPLIED AT THE MID-CHORD POINT AT TWO ANGLES RELATIVE TO THE SURFACE
I. Wygnanski Feb. 1964 59 p refs
(DRB Grant 9551-12)
(Rept. 64-3)

Experiments were made on a thin, two-dimensional aerofoil with sharp leading edge, and with a jet blowing through a midchord slot on the upper surface for boundary-layer and circulation control. The measurements were made at low Mach number and included the effect of altering the angle of blowing to help control the leading edge separation bubble. Variation of the blowing angle caused little change in lift coefficient, but produced an appreciable change in moment coefficient. With the jet discharging at an angle and subsequently reattaching to the surface, a separation bubble of low pressure was formed downstream of the slot, reducing the nose-up pitching moment about the quarter-chord point. Experimental results are in fair agreement with the latest jet-flap theory, and with theories for jet entrainment. Author

N64-19916 National Research Council of Canada, Ottawa
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 APRIL TO 30 JUNE 1963
W. J. Rainbird et al [1963] 123 p refs
(DME/NAE-1963(2))

This bulletin contains two reports: (1) the flow separation about cones at incidence; and (2) the fan-in-wing powerplant for VTOL aircraft, as well as progress reports in mechanics, hydrodynamics, aerodynamics, and thermodynamics. A.W.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-19805 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen, W. Germany Inst. für Flugmechanik
A SIMPLE SUBSTITUTE SYSTEM FOR HANDLING THE VIBRATION PROBLEMS IN AIRCRAFT [EIN EINFACHES ERSATZSYSTEM FUR DIE BEHANDLUNG VON SCHWINGUNGSPROBLEMEN AN FLUGZEUGEN]
Max Hacklinger Porz-Wahn, W. Germany, DVL Wesen, Mar. 1964 42 p refs In GERMAN
(DVL-268) Available from Universitats- u. Fachbuchhandlungen, Köhn, R.-Wagner Str. 1, W. Germany

A simple system for handling the vibration problems in aircraft is discussed. The elastic aircraft is reduced to a two spring–two mass system. This system is the equivalent of the oscillation vibrational energy and fuselage motion of the aircraft. Only the bending fundamental-oscillation frequency is considered, and the handling method is applicable only to wings without external loads. This method can be employed for calculating aerodynamic problems such as gust "attacks," landing and taxiing phenomena, and for recalculating the results of static vibration tests. Results of the vibration measurements, conducted on two sailplanes, are presented.
Trans. by I.v.L.

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-19421 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
KNOWLEDGE IS POWER
31 Oct. 1962 30 p Transl. into ENGLISH of two articles from Znaniye-Sila, no. 3, 1962 p 17–19
(FTD-TT-62-1304/1; AD-292229)

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1. SECRETS OF THE BLUE JET STREAM N. Petrova p 1–17 (See N64-19422 12-04)
2. BARRIER OF THE UNKNOWN Yu. Kibardin and M. Gallay p 18–26 (See N64-19423 12-04)

N64-19422 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Technology Div.
SECRETS OF THE BLUE JET STREAM
D. Arkad'yev *In its* Knowledge is Power 31 Oct. 1962 p 1–17 (See N64-19421 12-04)

This Soviet paper discusses some of the problems of aerodynamicists in designing structures capable of supersonic and hypersonic speeds and altitudes in flight. The only forms of experimentation now available to solve such problems are physical models of air currents and studies of gas flow in wind tunnels, the personal courage of test pilots, and theoretical research. The greatest obstacle to supersonic and hypersonic achievement is found in the wing form and fuselage of proposed machines. Using the wedge shape, as in the U.S. X-15 experimental plane, appeared to be a solution for the wing problem, and a possible solution for the fuselage was to construct it in the form of the two halves of a cone on both sides of the wing. A.W.

N64-19423 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Technology Div.
BARRIER OF THE UNKNOWN
Yu. Kibardin and M. Gallay *In its* Knowledge is Power 31 Oct. 1962 p 18–26 (See N64-19421 12-04)

A Soviet report is presented on experimental aircraft that is launched from a mother aircraft and flies at more than 6000 km/hour and at altitudes of 100 km. A.W.

N64-19760 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AIRCRAFT TODAY – SPACECRAFT TOMORROW
N. Krutov 11 Feb. 1964 10 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 7, 1963 p 18–19
(FTD-TT-63-1134/1; AD-433535)

The rocket plane for long-distance earth transportation is conceived of as a combination of ballistic rocket and supersonic aircraft, making flights at an altitude of 150 to 200 kilometers. It is thought to be the fastest and most economical means of transportation of the future. An additional application can be for use in communication between the earth and artificial satellites. The complex scientific and technical problems of creating such aerospacecraft are reviewed. R.L.K.

N64-19780 Advisory Group for Aeronautical Research and Development, Paris (France)
FREE AND SEMI-FREE MODEL FLIGHT-TESTING TECHNIQUES USED IN LOW-SPEED STUDIES OF DYNAMIC STABILITY AND CONTROL
John P. Campbell (NASA, Langley Res. Center) Oct. 1963 58 p refs
(AGARD-76)

The various free and semifree model flight-testing techniques used in low-speed studies of aircraft dynamic stability and control are summarized and discussed. The most appropriate uses for these flying-model techniques and the relative merit of the various techniques for particular applications are indicated. Author

N64-19787 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen, W. Germany Inst. für Flugmechanik
INVESTIGATIONS ON STEADY AND UNSTEADY LOADS OF SAILPLANES BY TOWING AND GUSTS [UNTERSUCHUNGEN UBER STATIONARE UND INSTATIONARE BELASTUNGEN VON SEGELFLUGZEUGEN DURCH WINDENSCHLEPP UND BOEN]
Max Hacklinger and Alfred Pietrass Porz-Wahn, W. Germany, DVLR Wiss. Berichtswesen, Mar. 1964 106 p refs In GERMAN
(DVL-267) DVLR: DM 24

A short review is given of the steady loading conditions during winch towing. For the calculation of gust loads on cable-restrained sailplanes, the system airplane cable is reduced to a two-mass system with the fundamental wing-banding mode taken into account. The sag of the cable that results from cable weight and aerodynamic drag causes a strongly nonlinear characteristic of the cable spring that has been determined by a stepwise procedure. A harmonic single gust of variable length is assumed for excitation. In order to cover the entire field of possible sailplane designs, a major number of examples is calculated, corresponding approximately to the corners of the field. The flying unrestrained sailplane is contained in this method as a simple special case. Method and results are of interest also for airplanes with flexible, unswept wings of not too small aspect ratio. Author

N64-19854 Advisory Group for Aeronautical Research and Development, Paris (France)
A RATIONALE FOR THE DETERMINATION OF CERTAIN VTOL HANDLING QUALITIES CRITERIA
Thomas E. Lollar (Boeing Co.) Jul. 1963 41 p refs In ENGLISH; FRENCH summary
(AGARD-471)

Described are the results obtained in VTOL handling quality studies utilizing fixed-base simulators under instrument flight conditions. Simulation techniques are described that give reliable results when operated by experienced pilots. The approach to handling-qualities criteria is made using servoanalysis techniques and measurements of the pilot describing function. Good correlation between the derived control system parameter boundaries of this report and flight test data on variable stability VTOL aircraft is shown. Analysis of the closed loop airplane-pilot system showed a lower bound on airplane damping of 0.75/sec to ensure tolerable closed loop stability for instrument flight conditions. For light stick forces there is an optimum pilot gain of approximately 10 in. of stick deflection per radian of attitude error. The maximum practical pilot gain is 60 in./rad. These pilot gain values coupled with crossover frequency criteria, form boundaries in terms of airplane damping and control sensitivity. Author

N64-19855 Advisory Group for Aeronautical Research and Development, Paris (France)
REVIEW OF HOVERING CONTROL REQUIREMENTS FOR VTOL AIRCRAFT BY A FLIGHT DYNAMICS ANALYSIS
H. M. Dathe (Dornier-Werke) Jul. 1963 33 p refs
(AGARD-472)

In accordance with the AGARD recommendations for handling qualities in hovering flight, the control power and the control thrust requirements for aircraft gross weights between 1 and 100 tons are estimated using statistical data for the moments of inertia. These results are compared with an analysis of the aircraft motions following disturbances and control inputs and with maneuverability. The effects of damping, dead time, gust level, etc., are investigated, and some control system design criteria are obtained. Author

N64-19891 Advisory Group for Aeronautical Research and Development, Paris (France)
MODELS FOR HELICOPTER DYNAMIC STABILITY INVESTIGATIONS
L. R. Lucassen and F. J. Sterk (Natl. Aero. and Astronautical Res. Inst.) Jul. 1963 15 p
(AGARD-470)

A mathematical model is described, which has been devised for improving the physical understanding of helicopter dynamic instability in hovering (two degrees of freedom). A demonstration model has been built according to this principle. The influence of parameters, artificial stabilization, and sling load on the dynamic characteristics is shown. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see:* 12 Geophysics, and 29 Space Sciences.

N64-19315* California U., San Diego
MOTIONS IN BARRED SPIRALS. VII. THE VELOCITY FIELD OF NGC 925
V. C. Rubin, E. M. Burbidge, and G. R. Burbidge Mar. 1964 12 p refs Submitted for Publication
(NASA Grant NsG-357)
(NASA CR-53823) OTS: $1.60 ph

Spectroscopic observations have been made of the nucleus and nine outer emission knots in NGC 925. The recession velocity of the galaxy is +710 km/sec. Across the central bar there is no variation in line-of-sight velocity. The outer knots have velocities within ±50 km/sec of the central value. Several possible explanations for the absence of any appreciable gradients in the velocity field are described, and the tentative conclusion is drawn that this is a galaxy with very small intrinsic angular momentum. Author

N64-19329 Joint Publications Research Service, Washington, D.C.
HISTORY OF THE ROTATION OF THE MOON AND THE RHEOLOGICAL PROPERTIES OF ITS SUBSTANCE
B. Yu. Levin *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 64–70 refs (See N64-19326 12-28) OTS: $6.00

The deviation of the moon from equilibrium shape is not a matter of tidal bulges, but rather of a considerable oblateness. Even so, this means that the material of the moon possesses a creep threshold of the order of 10 kg/cm^2. It is believed that the moon's oblateness indicates that it solidified under conditions of free rotation. Deceleration of the moon's rotation to the point of equalizing the periods of rotation and of revolution must have taken place as the result of significant dissipation of energy accompanying tidal deformations of the moon resulting from the earth's gravitational attraction.
Author

N64-19330 Joint Publications Research Service, Washington, D.C.
THE GROWTH OF TERRESTRIAL PLANETS
V. S. Safronov *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 71–88 refs (See N64-19326 12-28) OTS: $6.00

This article deals with the growth of planetary embryos that results from the simultaneous deposit of small particles and of larger bodies upon them. In the absence of granulation of bodies already present at an early stage of growth, the fine particles are swept out by the large bodies. The cloud is transformed into a "swarm," and the subsequent process of the growth of the planetary embryo consists of the acquisition of separate bodies. The complete elimination of fine particles in the swarm was preceded by the granulation of bodies during collisions. Taken into account is the influence of the relative

velocity of impinging bodies upon rates of growth of the earth—velocity determined by the gravitational relationship of the bodies with larger bodies and by the embryo of the planets. Author

N64-19331 Joint Publications Research Service, Washington, D.C.
THE ORIGIN OF THE SOLAR SYSTEM
H. Alfven *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 89–108 refs (See N64-19326 12-28) OTS: $6.00

A theory on the formation of the solar system is presented. The theory involves mainly the interaction of two forces, gravitation and electromagnetics. The only assumption it requires is that the intensity of the magnetic field exceed a certain minimal value. The theory applies both to the formation of the planets and of their satellites. P.V.E.

N64-19332 Joint Publications Research Service, Washington, D.C.
THE PROCESSES OF THE DISINTEGRATION OF LIGHT QUANTA AND THEIR SIGNIFICANCE IN THE PHYSICS OF GAS NEBULAE
A. Ya. Kipper and V. M. Tayt *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 109–124 refs (See N64-19326 12-28) OTS: $6.00

The significance of the biquantum transition $2P \rightarrow 1S$ in the hydrogen atom is examined in connection with the physics of planetary nebulae. In computing the probability w_2 of this transition, in addition to the continuous spectrum, a number of other lines also appear. Taking the probability value $w_2 = 1.94 \cdot 10^{-5}$ sec^{-1} (resonance is left out), it is demonstrated that in optically thick planetary nebulae, the principal cause of the rise of a continuous spectrum in the optical interval is to be found in the biquantum transition $2P \rightarrow 1S$. Author

N64-19333 Joint Publications Research Service, Washington, D.C.
THE PHYSICS OF PLANETARY NEBULAE
V. V. Sobolev *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 125–177 refs (See N64-19326 12-28) OTS: $6.00

A brief survey is presented of the physics of planetary nebulae. It includes nuclear temperatures, the theory of the Balmer decrement, forbidden lines in nebular spectra, electron temperatures, electron densities, the chemical composition of nuclei, continuous nuclear spectra, the diffusion of L_α radiation, radiation pressure, the structure of planetary nebulae, and the problem of the origin of planetary nebulae. Some criticisms of particular theoretical works are offered, and certain projects for future investigation are suggested. Author

N64-19334 Joint Publications Research Service, Washington, D.C.
THE DYNAMICS OF PLANETARY NEBULAE
G. A. Gurzadyan *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 178–238 refs (See N64-19326 12-28) OTS: $6.00

Several basic types of planetary nebulae are considered. These are: star type, planet type, two shell, ring type, bipolar, spiral-type, and diffuse (or transitional). Among the various topics discussed are the following: (1) the reality of planet-type nebulae and the succession of the forms of planetary nebulae—planet type to two shell to ring type; (2) the existence of magnetic fields within planetary nebulae; (3) the basic results of the quantitative theory of the formation of the second shell as a result of the tearing away of a portion of the basic shell under the influence of the light pressure of L_α-radiation; (4) several problems in the hydrodynamics of planetary nebulae; and (5) the origin of planetary nebulae in connection with the origin and development of stars. P.V.E.

N64-19335 Joint Publications Research Service, Washington, D.C.
LIGHT PRESSURE AND THE DYNAMICS OF PLANETARY NEBULAE
I. N. Michin *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 239–252 refs (See N64-19326 12-28) OTS: $6.00

Studied is a field of L_α-radiation in a planetary nebula that is expanding with a velocity gradient, and is divided into two portions—ionized and nonionized. It is shown that the magnitude of the force of light pressure caused by L_α-radiation reaches a maximum in the layer transitional from the ionized portion to the nonionized portion. A joint study is made of a field of L_α-radiation in a nebula and its dynamics. On the basis of the solution a theoretical interpretation of the formation process of two-shell nebulae is made. Author

N64-19336 Joint Publications Research Service, Washington, D.C.
THE INTERACTION BETWEEN STARS AND DIFFUSE MATTER
T. A. Agekyan *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 253–273 refs (See N64-19326 12-28) OTS: $6.00

An expression is derived for the acceleration of a star in its interaction with a system of immobile dust clouds, taking into account the forces of gravitation and light pressure. In the case of stars of low luminosity, the acceleration is negative, and very small; for stars of high luminosity the acceleration is positive and may be very large. The expression relates to hot giants, in which case the force of attraction of the stellar gaseous material is negligibly small in comparison with the force of light pressure. The acceleration experienced by hot giants as a result of their interaction with diffuse matter may be the explanation of the familiar phenomenon of the accumulation of residual velocities of O and B stars in transition from early to late subclasses. Author

N64-19337 Joint Publications Research Service, Washington, D.C.
MAGNETOGASDYNAMICS AND PROBLEMS OF COSMOGONY
S. A. Kaplan *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 274–304 refs (See N64-19326 12-28) OTS: $6.00

Presented are the basic positions and main achievements of magnetogasdynamics—the existence of a "freezing-in" integral, the description of "entanglement" and "disentanglement" of magnetic lines of force in gasomagnetic shock waves, and the concept of gasomagnetic turbulence. The following cosmogonic hypotheses, which make use of magnetogasdynamics, are presented: (1) the link between spiral arms and the regular magnetic field; (2) the formation of interstellar gas clouds as separate vortex cells of interstellar gasomagnetic turbulence; (3) the formation of a gaseous galactic halo as the result of magnetic pressure and the pressure of cosmic rays on magnetized interstellar space; (4) the formation of filamentary nebulae as the result of possible instability in gasomagnetic shock waves; (5) the formation of the magnetic fields of stars as part of the process of condensation; and (6) the acceleration of cosmic-ray particles in a gasomagnetic medium. Author

N64-19338 Joint Publications Research Service, Washington, D.C.

THE MAINTENANCE OF ISOTOPIC ABUNDANCE IN THE FORMATION OF ELEMENTS

P.G. Parkhomenko *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 305–308 refs (See N64-19326 12-28) OTS: $6.00

In a thermonuclear medium at temperatures above 10^8K, photodisintegration will obstruct the radiative capture of nucleons by the nuclei of light elements. These nuclei therefore remain in the "frozen" state. If the temperature falls below 10^8K, the life of a nucleus between two successive captures will be of the order of 10^4 years, during which time total rarefaction and cooling of the medium can take place. Author

N64-19339 Joint Publications Research Service, Washington, D.C.

THE LOCATION OF AN EQUILIBRIUM THERMO-NUCLEAR MEDIUM

P.G. Parkhomenko *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 309–315 refs (See N64-19326 12-28) OTS: $6.00

Determined is the mass of an object in which, under equilibrium conditions, the observed abundances of elements and isotopes can be established. For a statistical equilibrium nuclear gas, values are taken for temperature and nucleon concentrations determined for the isotopes of light elements. In the case of helium concentrations, plausible assumptions are made. The mass arrived at is approximately 2,000 M, considerably smaller than the mass of the galaxy and the metagalaxy, lying between the masses of globular and open star clusters. Author

N64-19340 Joint Publications Research Service, Washington, D.C.

THEORIES OF THE "EQUILIBRIUM" ORIGIN OF ELEMENTS

S. B. Pikel'ner *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 316–317 refs (See N64-19326 12-28) OTS: $6.00

Theories for explaining the synthesis of complex atoms from simpler ones and for explaining the existing abundances of various chemical elements are discussed. "Equilibrium" theories meet with the difficulty that a comparison of the abundances of isotopes and elements with their binding energies does not give the relationship that is expected. Accordingly, a search has been carried out for nonequilibrium reactions taking place at comparatively low temperatures. Nonequilibrium-type theories do not explain the formation of the middle group of nuclei, beginning approximately with Na and running to Hg. From the point of view of nonequilibrium processes, it is not understandable why for isotopes of a number of the middle elements good correspondence is found between the excess and the binding energy, a point that is characteristic of the equilibrium theory. P.V.E.

N64-19341 Joint Publications Research Service, Washington, D.C.

THE PRESENT STATUS OF COSMOLOGY

G. N. Naan *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 318–373 refs (See N64-19326 12-28) OTS: $6.00

Cosmology may be regarded as: (1) a division of astronomy; (2) a division of physics; or (3) a division of philosophy. Present-day cosmology is most closely associated with extragalactic astronomy, which it partially overlaps, and may be regarded, first of all, as a theoretical generalization of the data of extragalactic astronomy. The discussion presented is divided into the following topics: (1) cosmological paradoxes; (2) relativistic cosmology; (3) postulative theories; (4) cosmology and experience; and (5) tendencies and perspectives. It is suggested that present cosmological models can in no way be regarded as models of the whole universe, and that they are only sketchy descriptions of some of the important general features of the metagalaxy. P.V.E.

N64-19342 Joint Publications Research Service, Washington, D.C.

PROBLEMS OF COSMOGONY, VOLUME II

21 Apr. 1964 383 p refs Transl. into ENGLISH of the collection of articles "Voprosy Kosmogonii Vol. II Moscow, Acad. of Sci., USSR 1954 p 1–363
(JPRS-24260; OTS-64-31104) OTS: $5.00

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N64-19343 Joint Publications Research Service, Washington, D.C.

HYPOTHESIS OF STAR FORMATION

A. I. Lebedinskiy *In its* Probl. of Cosmogony, Vol. II 21 Apr. 1964 p 1–157 refs (See N64-19342 11-05) OTS: $5.00

A qualitative exposition of the hypothesis of the formation of stars from diffuse matter is presented along with a quantitative investigation of individual problems that are important for the hypothesis. The following divisions are made in the discussion: (1) hypothesis of the gravitational condensation and evolution of galaxies—formation of stars from diffuse matter, protogalaxies, evolution of forms of galaxies; (2) evolution and development of stars—moment of momentum of protostars, loss of mass and momentum in the process of ordinary star evolution, star distribution and distribution of diffuse matter in the neighborhood of the sun, development of giants; (3) stellar systems—development of open clusters and the course of evolution of their component stars on the spectrum-luminosity (Hertzsprung–Russell) diagram, double and multiple stars, star clouds and associations, chemical composition of stars and transformation elements; (4) maximum possible star masses—stars in equilibrium, radii of protostars, stability of stars with respect to division; and (5) gravitational condensation of diffuse matter and stellar gas—the criterion of gravitational instability, gravitational condensation in a plane-parallel layer, gravitational condensation of "stellar gas," entropy of a plane-parallel layer of stars, formation of clouds in stellar gas, energy balance of diffuse matter, confirmation by observation of the existence of star clouds. P.V.E.

N64-19344 Joint Publications Research Service, Washington, D.C.

EVOLUTION OF STELLAR SYSTEMS

L. E. Gurevich *In its* Probl. of Cosmogony, Vol. II 21 Apr. 1964 p 158–276 refs (See N64-19342 12-05) OTS: $5.00

It is assumed that stars are being formed at the present time from diffuse matter. The discussion is divided into the following areas: (1) equilibrium of a rotating gravitational system—equilibrium form of a gravitational system, approximate theory of the equilibrium of a rotating gravitational system; (2) the mechanism leading to the evolution of the form of the galaxy—increase of the dispersion of velocities at the time of gravitational encounters of stars and stellar systems, kinetics of thickening of a stellar system, relationship between the components of the residual velocities of stars parallel to the axis of the galaxy and its plane, determination of the vertical distribution of stars, kinetics of self-destruction of clusters; (3) rotation of stars and their magnetic fields—distribution of the axes of rotation of stars, scattering of rotational axes of stars and their magnetic fields; and (4) formation of the elements—theory of statistical equilibrium in super-dense media and the theory of an "expanding universe," interstellar electromagnetic fields and acceleration of particles, mechanisms of the formation of complex nuclei in the interstellar medium. P.V.E.

N64-19345 Joint Publications Research Service, Washington, D.C.

SEPARATION OF THE MAIN SEQUENCE INTO TWO PARTS

P. P. Parenago *In its* Probl. of Cosmogony, Vol. II 21 Apr. 1964 p 277–286 refs (See N64-19342 12-05) OTS: $5.00

It is shown that the main sequence of spectrum-luminosity diagrams should be regarded as consisting of two parts. It was found that the kinematic characteristics of the stars of the main sequence retain approximately the same value for stars of spectral types O-F. For stars of types G-M, these characteristics also retain the same value, but have a completely different value than that for the first part of the main sequence. The stars on the border of the two parts form a mixture whose kinematic characteristics for small sectors (late subdivisions of the F type) acquire intermediate values. P.V.E.

N64-19346 Joint Publications Research Service, Washington, D.C.

THE INFLUENCE OF STELLAR ENCOUNTERS ON THE "ECCENTRICITY-SEMIMAJOR AXIS" CORRELATION

S. A. Kaplan *In its* Probl. of Cosmogony, Vol. II 21 Apr. 1964 p 287–290 refs (See N64-19342 12-05) OTS: $5.00

The influence of stellar encounters, both on the semimajor axes and on the eccentricities of elliptical orbits of wide double systems, is discussed. It is concluded that a mean increase in the semimajor axis is accompanied by a corresponding decrease of eccentricity. When interpreted graphically, this means that in elliptical wide pairs, the stars are situated a large part of the time near the apoastria, where the disturbing force causing the increase in the semimajor axis also causes a corresponding decrease of eccentricity and vice versa. From this, it is concluded that the observed correlation "semimajor axis eccentricity" cannot be attributed to the influence of stellar encounters, and that the existence of the correlation actually supports the proposition that statistical stellar encounters do not play a significant role in either the formation or evolution of double stars. P.V.E.

N64-19347 Joint Publications Research Service, Washington, D.C.

THE INTERSTELLAR MEDIUM. I. DISTRIBUTION IN SPACE, MOTION AND PHYSICAL PROPERTIES OF THE INTERSTELLAR MATTER

V. S. Sifronov *In its* Probl. of Cosmogony, Vol. II 21 Apr. 1964 p 291–331 refs (See N64-19342 12-05) OTS: $5.00

An attempt is made to summarize the results of studies on the interstellar medium and to describe the principal properties of the medium. Areas of discussion include: (1) density and mass of the interstellar matter; (2) clouds of interstellar matter; (3) motions of interstellar clouds; (4) the problem of the identity of gas and dust clouds; (5) regions of ionization of the interstellar gas; (6) distribution of kinetic energy and the temperature of the interstellar medium; (7) composition and density of the interstellar gas; (8) dimensions and composition of interstellar particles; and (9) light absorption in interstellar space. P.V.E.

N64-19354* California U., San Diego
THE ROTATION AND MASS OF NGC 1792
V. C. Rubin, E. M. Burbidge, G. R. Burbidge, and K. H. Prendergast (Columbia U.) Feb. 1964 12 p refs Submitted for Publication Contrib. from the McDonald Obs., Texas U., No. 000 (NASA Grant NsG-357)
(NASA CR-53848) OTS: $1.60 ph

The rotation of the Sc galaxy NGC 1792 has been determined. By analyzing the observed rotation curve, density distributions and total masses as functions of the assumed c/a ratio of the galaxy have been obtained. It is found that the total mass is very close to $1.8 \times 10^{10} M_{\odot}$ and the mass-to-light ratio (photographic) is approximately unity. NGC 1792 is very similar in appearance to NGC 157 and NGC 1086, and its rotation curve and total mass are likewise very similar. Author

N64-19451 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF COSMOGONY, VOLUME V
27 Apr. 1964 279 p refs Transl. into ENGLISH of the collection of articles "Voprosy Kosmogonii", Vol. V Moscow, Acad. of Sci. USSR, 1957 p 1–299
(JPRS-24358; OTS-64-31162) OTS: $4.00

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N64-19452 Joint Publications Research Service, Washington, D.C.
EXPLOSIONS OF METEORS AS A FACTOR IN THE DEVELOPMENT OF THE LUNAR SURFACE
N. N. Sytinskaya *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 8–15 refs (See N64-19451 12-05) OTS: $4.00

The question as to the role of endogenic and exogenic factors in the formation of the lunar surface is considered. Sun-moon investigations reveal endogenic factors as the probable primary cause, but exogenic factors, such as photon and corpuscular solar radiation and, in particular, the impact of meteoric bodies cannot be ignored. The problem consists of how to evaluate the effectiveness of the exogenic factors upon the moon's substance. This paper offers evidence that exogenic factors were more significant than endogenic factors in lunar-surface development. A.W.

N64-19453 Joint Publications Research Service, Washington, D.C.
THE HYPOTHESIS OF TURBULENCE IN THE PROTOPLANETARY CLOUD
V. S. Safronov and Ye. L. Ruskol *In its* Probl. of Cosmogony Vol. V 27 Apr. 1964 p 16–38 refs (See N64-19451 12-05) OTS: $4.00

One of the important factors determining the evolution of the protoplanetary cloud is how matter moves within the protoplanetary cloud. Turbulence within the cloud is believed to have prevented gravitational instability. The formation of planetary embryos here could have proceeded only by the direct growth of solid particles as they collided with other particles and with gas atoms. The redistribution of matter and momentum within the cloud was restricted due to the damping of turbulence. For gravitational instability, it is not only required that there be no turbulence within the cloud, but that the relative particle velocities do not exceed 1 cm/sec of the distance of the earth from the sun and $\sim 10^2$ cm/sec in the region of the major planets. In cloud portions close to the sun, macroscopic movements could have existed caused by solar activity, preventing gravitational instability in this area. In cloud portions far from the sun, the conditions for gravitational instability were more favorable. Author

N64-19454 Joint Publications Research Service, Washington, D.C.
THE ORIGIN OF THE EARTH GROUP OF PLANETS
V. A. Krat *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 39–46 refs (See N64-19451 12-05) OTS: $4.00

This article attempts to refute criticism of the author's hypothesis on the origin of the solar system. It details further his theory of a two-stage formation of the planets. It restates his conclusion that the sun's original brightness of 100 times

its present brightness refers to the phase of the sun's development at which planetary formation was concluded—the WR stage characterized by intensive streaming of gas from the sun. A.W.

N64-19455 Joint Publications Research Service, Washington, D.C.
EVOLUTION OF THE STARS IN DIFFUSE STELLAR CLUSTERS AND STELLAR ASSOCIATIONS
A. G. Masevich *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 47–72 refs (See N64-19451 12-05) OTS: $4.00

This paper presents an evolutionary interpretation of luminosity-spectrum diagrams of diffuse clusters and stellar associations. The evolutionary pathways of the brightest stars of the Pleiades and Hyades clusters are calculated in detail. In stellar associations, the brightest stars are young stars entering the main sequence in the region of its newest spectral classes. The evolutionary pathway of a gravitationally shrinking star losing mass due to rotational instability is examined, and an estimate of the age of associations and diffuse clusters is given. A.W.

N64-19456 Joint Publications Research Service, Washington, D.C.
CENTRAL AND PERIPHERAL THEORY OF CEPHEID PULSATIONS
S. A. Zhevakin *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 73–107 refs (See N64-19451 12-05) OTS: $4.00

A boundary problem concerning nonadiabatic eigenoscillations of stars was formulated as a problem of finding such a solution of the main differential equations—both mechanical and thermal—for which the oscillatory energy is finite. For the problem of the nonadiabatic eigenoscillations of a polytropic model, with index $n = 3$ and opacity coefficient $\chi = \chi_0 \rho T^{-3}$ described by differential equations with peculiarities at the center and along the periphery of the polytropic model, the requirement of finiteness of the oscillatory energy is equivalent to the requirement of finiteness of the solution at the center and at the periphery of the polytropic sphere. Two boundary conditions meeting this requirement were written in an explicit form for the center and for the periphery. Author

N64-19457 Joint Publications Research Service, Washington, D.C.
ON THE SPATIAL AMPLITUDE DISTRIBUTION IN A PULSATING STAR
D. A. Frank-Kamenetskiy *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 108–134 refs (See N64-19451 12-05) OTS: $4.00

The properties of the solutions of linearized nonadiabatic pulsations are examined. A quasi-adiabatic solution is proposed and it is shown that giant stars that are really pulsating do not satisfy the condition of quasi-adiabaticity. All particular solutions, except for a single regular one, take on the nature of entropy waves whose amplitude increases without bound. The wavelength decreases inward from the surface. The regular solution results from the interference of two such entropy waves where they mutually extinguish themselves far from the surface. The distribution of displacement amplitudes depends on the phase relations between the entropy waves and the displacement oscillations. The phase relationships for the homogenous peripheral zone (constant adiabatic index) proved to be such that the displacement oscillations are rapidly gapped inward from the surface. Author

N64-19458 Joint Publications Research Service, Washington, D.C.
MAIN SEQUENCE IN THE SPECTRUM-LUMINOSITY DIAGRAM AND ITS THEORETICAL INTERPRETATION
A. G. Masevich *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 135–165 refs (See N64-19451 12-05) OTS: $4.00

The empirical mass-luminosity and mass-radius relations of main-sequence stars are examined. The modern theory of the internal constitution of stars and the energy sources of these stars is shown to be compatible with these empirical relations only if the mean molecular weight μ changes continuously along the sequence [$\mu = \mu(M)$]. Variations in μ, and also in other characteristics of the star along the main sequence, is interpreted as the result of their evolutionary changes. Different possible evolutionary pathways of the main-sequence stars are considered (stars with constant and with variable mass; in the presence and in the absence of complete mixing). Only an evolution with decreasing mass affords an explanation of the first part of the main sequence, in accord with empirical relations and the observed luminosity function. Author

N64-19461 Joint Publications Research Service, Washington, D.C.
POSSIBILITY OF THE FORMATION OF CHEMICAL ELEMENTS UNDER THE INFLUENCE OF COSMIC RAYS
V. A. Petukhov *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 181–184 refs (See N64-19451 12-05) OTS: $4.00

The mechanism of the formation of elements proposed by L. G. Gurevich is considered. This mechanism may lead to the decomposition but not to the synthesis of the elements. Author

N64-19497 California U., San Diego
A REVIEW OF ATOMIC ABUNDANCES IN CHONDRITES AND THE ORIGIN OF METEORITES
Harold C. Urey Repr. from Rev. of Geophys., v. 2, no. 1, Feb. 1964 p 1–34 refs Presented at the Nobel Laureates Conf. at Lindau, Germany, Jun. 1962
(NASA Grant NsG-323-63)

A review of the sources of analytical data for the chondritic meteorites is given, and the latest data, particularly for the minor elements, are tabulated. Though the composition of the chondrites is remarkably constant as compared with terrestrial rocks, important variations in the concentrations of certain major and minor constituents occur, which make it impossible to conclude that any one type of chondrite could have been produced from another by simple physical processes. This is true for the carbonaceous, enstatitic, and the high- and low-iron-group chondrites. The origin of these chondrites is discussed mostly with reference to the author's suggestions about the origin of the solar system. Author

N64-19567* IIT Research Inst., Chicago, Ill. Astro Sciences Center
THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: JUPITER
D. L. Roberts 9 Mar. 1964 21 p refs
(NASA Contract NASr-65(06))
(NASA CR-53735; P-1; Formerly part of Rept. 1.4P2 No. 2, Sep. 1963) OTS: $2.60 ph

The theories of origin of Jupiter are discussed and are followed by a summary of the physical properties of Jupiter. The measurements that are proposed are (1) spectrometry and polarimetry of the Jovian atmosphere and, if possible, of the surface; (2) photography of the complex atmospheric appearance of Jupiter, including observations through holes in the cloud cover either at the poles or over the Red Spot; (3) magnetic field measurements throughout the mission and in the supposedly high-intensity field of Jupiter, which may extend to 1 au from the surface; (4) temperature measurement using microwave techniques to measure temperatures under the

cloud layer; (5) detection of plasma and particles in space and in the proposed intense radiation belts; and (6) measurement of interplanetary dust and, in particular, any dust cloud associated with Jupiter. Author

N64-19568* IIT Research Inst., Chicago, Ill. Astro Sciences Center
THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: THE SATELLITES OF JUPITER
D. L. Roberts 9 Mar. 1964 17 p refs
(NASA Contract NASr-65(06))
(NASA CR-53736; P-2; Formerly part of Rept. 1.4P2 No. 2, Sep. 1963) OTS: $1.60 ph

The satellites of Jupiter are arranged in three distinct groups, the outermost group having retrograde motion. The origins of the three groups are discussed and are followed by a summary of the known physical properties of the satellites. The majority of the available data is restricted to the four largest satellites that are in the group closest to Jupiter. The basic measurements suggested are (1) visual measurements using photography or television, (2) spectrometry and polarimetry to provide data on the gross nature of the surface, (3) magnetic field measurements in interplanetary space, in the Jovian field, and, if possible, in any local satellite magnetic field, (4) micrometeorite and charged particle measurements, and (5) biological measurements. Author

N64-19569* IIT Research Inst., Chicago, Ill. Astro Sciences Center
THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: COMETS
D. L. Roberts 9 Mar. 1964 18 p refs
(NASA Contract NASr-65(06))
(NASA CR-53777; P-3; Formerly part of Rept. 1.4P2 No. 2, Sep. 1963) OTS: $1.60 ph

The aspects of comets dealt with are their origin and their structure. The measurements that are briefly considered from a space probe on approach to and within the coma and tail are (1) visual, using television to look at the nucleus in particular; (2) plasma and charged particle experiments; (3) micrometeorite and dust measurements; (4) magnetic field plotting; and (5) spectral measurements with mass spectrometry as the more important spectral measurement. The comets that are considered for interception are short period ones having perihelion passages in the next 10 to 15 years. A brief discussion is included on the use of artificial comets that can be released into earth orbit either as gases or as simulated ice nuclei.
Author

N64-19586* Kansas U., Lawrence Center for Research in Engineering Science
EFFECTS OF STRUCTURE SIZE ON MOON AND EARTH RADAR RETURNS AT VARIOUS ANGLES
A. K. Fung and R. K. Moore Repr. from J. Geophys. Res., v. 69, no. 6, 15 Mar. 1964 p 1075–1081 refs
(NASA Grant NsG-477; NASA Grant NsG-298-62)

Radar scatter from lunar and terrestrial surfaces is compared with theoretical calculations based on a novel autocorrelation function for surface-height deviation from the mean. A very close fit is obtained with the lunar experimental return curves of Evans and Pettengill over the entire range from normal incidence to 85° from normal. The correlation function approaches different exponentials for different lag distances. The autocorrelation differs from the slowly varying exponential only near the origin. Large-scale features determine the return at near-normal incidence and small-scale features determine that from nearer grazing incidence. Author

N64-19601* General Dynamics Corp., San Diego, Calif. General Atomic Div.
ABUNDANCES OF Na, Sc, Cr, Mn, Fe, Co, AND Cu IN 92 METEORITES, 9 TERRESTRIAL SPECIMENS, AND 90 INDIVIDUAL CHONDRULES Quarterly Progress Report, Sep. 1–Nov. 30, 1963
R. A. Schmitt and R. H. Smith 17 Dec. 1963 47 p refs
(NASA Contract NASw-843)
(NASA CR-53779; GA-4782) OTS: $4.60 ph

Element abundances were determined by the technique of instrumental neutron-activation analysis. Histograms and tables are given showing the results. The Na and Mn distributions in chondrules are compared with their distribution in ordinary whole-rock-type chondrites. Average meteoritic and terrestrial abundances are compiled in the various meteorite classifications, and also as a function of chondritic subclass and of H- or L-group. Abundances were determined in individual chondrules from four chondrites: Allegan and Ochansk (two H-group chondrites), Bjurböle (an L-group chondrite), and Chainpur (a Type-III carbonaceous chondrite). The abundances determined for each element are discussed, as are individual meteorites with "abnormal" abundances, and the homogeneity of chondrites. R.L.K.

N64-19602* General Dynamics Corp., San Diego, Calif. General Atomic Div.
ABUNDANCES OF Na, Sc, Cr, Mn, Fe, Co, AND Cu IN 18 METEORITES AND 146 INDIVIDUAL CHONDRULES Quarterly Progress Report, Dec. 1, 1963–Feb. 29, 1964
R. A. Schmitt 29 Feb. 1964 63 p refs
(NASA Contract NASw-843)
(NASA CR-53776; GA-4997) OTS: $6.60 ph

Abundances of seven elements—Na, Sc, Cr, Mn, Fe, Co, and Cu—were determined through instrumental-neutron-activation analysis (INAA) in 18 meteorites and 146 individual chondrules separated from seven meteorites. Cumulative frequency distributions for abundances were plotted, using linear probability paper. A.W.

N64-19603* IIT Research Inst., Chicago, Ill. Astro Science Center
ACCURACY AND CAPABILITIES OF THE ASC/IITRI CONIC SECTION TRAJECTORY SYSTEM
P. M. Pierce and F. Narin [1964] 36 p refs
(NASA Contract NASr-65(06))
(NASA CR-53850; Rept. T-5) OTS: $3.60 ph

This report discusses the accuracy and capabilities of the system and some of the studies that have been performed with it. It shows that the planetary, asteroid, and comet orbital elements are adequate for conic section trajectory studies. Transitions are shown to be smooth for elliptical to parabolic to hyperbolic trajectories. A complex launch hyperbolic excess speed vs date of launch curve for 100-day flights to asteroid Eros is explained in detail to illustrate the physical meaning behind the somewhat complex energy requirements of interplanetary flight. The options available in the ASC/IITRI system for flights to points anywhere in the solar system are outlined. An annotated listing of programs and subroutines is included. Author

N64-19620* California U., San Diego
MOTIONS IN BARRED SPIRALS. VI. THE ROTATION AND VELOCITY FIELD OF NGC 613
E. M. Burbidge, G. R. Burbidge, V. C. Rubin, and K. H. Prendergast (Columbia U.) Feb. 1964 22 p refs Submitted for Publication
(NASA Grant NsG-357)
(NASA CR-53825) OTS: $2.60 ph

From spectra taken at McDonald and Lick Observatories, velocities in the nucleus and in the outer emission knots of the barred spiral NGC 613 were measured. The recession velocity of the galaxy is +1493 km/sec. From the steep velocity gradient across the nucleus a mass of 9×10^9 $M_\odot$ for the nuclear region is determined. The northwest emission knots, 80 sec from the center, have velocities of the order of 150 km/sec with respect to the nucleus. The southeast emission knots have velocities that range from almost 0 (60 sec from the center) to 250 km/sec (100 sec from the center), with respect to the nucleus. To account for this strange velocity variation, various models are considered. Author

N64-19710* California Inst. of Tech., Pasadena Div. of Geological Sciences
10-μ PHOTOMETRY OF 25 STARS FROM B8 TO M7
Robert L. Wildey and Bruce C. Murray Repr. from Astrophys. J., v. 139, no. 2, 15 Feb. 1964 p 435–441 refs
(NASA Grant NsG-56-60)

Described are measurements taken with a photometer employing a liquid hydrogen-cooled mercury-doped germanium photoconductor whose spectral response is limited to the 8μ to 14μ region by a low-pass interference filter and a BaF_2 window coupled with the cell's threshold wavelength. The photometer has been placed at the east-arm Cassegrain focus of the 200-in. Hale telescope. The earliest star for which two measurements have been obtained is the B8-Ia star β Orionis. The latest star is the M7e star χ Cygni. The brightest star, 1.68×10^{-14} watts/cm$^2\mu$, is α Orionis. The carbon star DS Peg was also measured. In a two-color diagram formed with B and V there are an intrinsic increase in dispersion going to later type stars and a systematic trend away from the blackbody relation. Author

N64-19715* Cornell U., Ithaca, N.Y.
THE INITIAL DEVELOPMENT OF H II REGIONS
W. I. Axford Repr. from Astrophys. J., v. 139, no. 2, 15 Feb. 1964 p 761–763 refs
(NASA Grant NsG-382)

A rough analysis is presented of the initial development of a gaseous nebula making an allowance for the effects of absorption of ionizing radiation in the H II region. The star ionizing the nebula is assumed to begin radiating at time t = 0 and to emit a constant total flux S_* of ionizing photons. Except in the very early stages, the resulting ionization front is thin compared with the radius (R) of the H II region and may be treated as a discontinuity. As a first approximation it is assumed that apart from being almost fully ionized and heated to a temperature of about $10^{4\circ}$ K, the interstellar gas surrounding the star is not appreciably disturbed by the passage of the ionization front while it remains weak R type; in particular, the density of the gas is unchanged. IAA

N64-19790* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
INTERPRETATION OF RESULTS FROM SURVEYOR ALPHA-SCATTERING EXPERIMENT
Alden A. Loomis 30 Apr. 1964 17 p refs
(NASA Contract NAS7-100)
(NASA CR-53876; JPL-TR-32-606) OTS: $1.60 ph

Rocks on the moon's surface may differ from rocks below because of contamination by meteoritic infall, sputtering, and extensive mixing by impact. The broad categories of igneous rocks and meteorites, which are familiar on earth are the best models for rocks on the moon. Anhydrous igneous rocks and meteorites may be categorized based on their atomic percentage of oxygen. The Si/Na ratio is another reliable chemical parameter; terrestrial anhydrous igneous rocks and meteorites occupy well-defined fields in a plot of oxygen percentage vs Si/Na. The best parameter to resolve ambiguities in such a plot is the Mg/Si ratio; chief drawback is accuracy. More sophisticated subdivisions could be made if Ca and K could be separated. Classification should not be based on using iron as an indicator. The concurrence of high Mg/Si and Mg/Na ratios with oxygen contents over 60% indicates water in the sample. The amount of water can be estimated by balancing the cations and anions in the actual analysis. Concomitant measurements of the magnetic susceptibility and bulk density of the sample help chemical interpretation. Television of the analyzed spot and the area surrounding the spacecraft is necessary to supply megascopic rock texture, structure, and field relations data. Author

N64-19804* Maryland U., College Park
JUPITER
E. J. Öpik Repr. from Irish Astron. J. (Armagh), v. 6, no. 4, Dec. 1963 p 135–149 refs
(NASA Grant NsG-58-60)
(*Its* Leaflet 58)

This report proves that the theory of the hydrogen-snowball process of accretion concerning the planet Jupiter can give qualitatively, as well as quantitatively, an adequate account of the difference in composition between the planet's atmosphere and its main body—a mainly hydrogenic interior comprising the bulk of Jupiter's mass and a predominantly helium atmosphere. A.W.

N64-19920 California Inst. of Tech., Pasadena Owens Valley Radio Obs.
OCCULTATION OF THE CRAB NEBULA BY THE SOLAR CORONA IN JUNE 1963 Observation No. 10
J. D. Wyndham and B. G. Clark 1963 5 p refs
(Contract Nonr-220(19))
(AD-428675)

This report is concerned with the indication of a progressive increase in the angular diameter of a radio source, due to scattering by irregularities of electron density in a nonuniform corona, with decreasing angular distance from the sun. Consideration is given to this effect occurring at meter wavelengths, and to a simple scattering theory in which the angular extent of the scattered distribution produced when a point source is viewed through the corona is proportional to the square of the wavelength. Angular diameters, inferred from observation, cannot be accounted for by the simple scattering theory. Observations were made of the Crab Nebula, utilizing two antennas as an east–west interferometer. With this arrangement, the quiet sun was largely resolved and gave a contribution to the total response, but this was only a fraction of the response due to the source itself. These observations gave no evidence of the existence of enhanced scattering at centimeter wavelengths that cannot be accounted for by the simple theory applicable at meter wavelengths. C.L.W.

N64-19945* Maryland U., College Park
ON THE GALACTIC AND EXTRAGALACTIC PROPAGATION OF COSMIC RAYS Physics Department Technical Report No. 373
Howard Laster [1963] 21 p refs
(NASA Grant NsG-58-60)
(NASA CR-53900) OTS: $2.60 ph

A model for the origins of cosmic radiation is examined in which nonsolar primaries below 10^{17}ev are assumed to come from supernovae within the spiral arms of our galaxy and those

at higher energies are attributed to extragalactic sources. Supernova-produced particles are taken as diffusing first in the spiral arm region, then leaking into the galactic halo where they travel with a larger diffusion mean free path, and eventually diffusing into extragalactic space. These particles are observed with the characteristic energy and mass spectra with which they are injected into the spiral arms, except in the energy range 10^{15} to 10^{17} ev where they begin to see longer effective mean free paths and to escape more easily from the spiral arms. The energy spectrum is consequently steepened in this range and the abundance of primaries shifted towards heavier nuclei. Above approximately 10^{17} ev the flux from supernovae falls below that of another cosmic-ray population originating in extragalactic sources and taken as diffusing throughout the local supercluster of galaxies. Author

N64-19954* Columbia U., New York, N.Y.
[THEORETICAL AND ANALYTICAL STUDIES OF PLANETARY AND STELLAR STRUCTURES, EVOLUTION AND DYNAMICAL PROCESSES; AND THE APPLICABILITY OF GEOPHYSICAL METHODS TO SUCH STUDIES] Status Report, Apr. 1, 1963-Sep. 30, 1963
[1963] 3 p
(NASA Grant NsG-445)
(NASA CR-53869) OTS: $1.10 ph

This program of research stresses the following areas: radiative and convective transfer in planetary atmospheres, physics of the upper atmosphere, applications of plasma physics to geophysical and astrophysical problems, stellar structure and evolution, and stellar and galactic dynamics. C.L.W.

N64-19984* RAND Corp., Santa Monica, Calif.
GEOMETRIC AND PHOTOMETRIC PARAMETERS OF THE TERRESTRIAL PLANETS
G. de Vaucouleurs Mar. 1964 131 p refs
(NASA Contract NASr-21(04))
(NASA CR-53507; RM-4000-NASA) OTS: $10.50 ph

A critical examination is presented of the diameters, ellipticities, and spectral albedos of Mercury, Venus, and Mars derived by many observers in the course of the past 100 years. The systematic and accidental errors in the various methods are discussed, and the results are weighed accordingly, to produce best estimates of the diameters, ellipticities, and albedos for the three planets. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-19303 North American Aviation, Inc., Los Angeles, Calif. Environmental Lab.
PRELIMINARY INVESTIGATION FOR A ZERO-GRAVITY WATER SEPARATOR
S. J. Colaprete 23 Sep. 1963 23 p refs
(NA-63-1097)

Tests were performed on a "liquid lock" material (Refrasil A-100 fiber glass batt) and capillary tube configurations appropriate for zero-gravity water separator systems. This program was designed to supply specific information for subsequent development of a prototype zero-gravity water separator. Author

N64-19351* Stanford U., Calif.
THE COMPUTATION OF APPROXIMATELY OPTIMAL CONTROL
B. B. Gragg, Jr. Jan. 1963 113 p refs
(NASA Grant NsG-133-61)
(NASA CR-53781; SUDAER 179) OTS: $9.60 ph

This research is concerned with the problem of optimal control of dynamic systems, where optimality here implies the minimization of some specified cost integral during the control process. The maximum principle of Pontryagin provides the theoretical basis for the proposed synthesis procedure. Application of the maximum principle in a given control problem yields an optimal control law that is a function of both the known system state vector and an associated unknown adjoint vector. At each point in state space this adjoint vector can be identified as the negative gradient of a certain scalar function of state, the optimal cost function, defined to be the minimal cost obtainable when that point serves as the initial condition for the dynamic process. The basic concept of the synthesis procedure described here is the functional approximation of the optimal cost and the use of this approximation in place of an exact representation to obtain a control law that is nearly optimal. Author

N64-19376 Radio Corp. of America, Camden, N.J.
DIRECT ENERGY CONVERSION Technical Papers
[1963] 48 p refs

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10. SUPERCONDUCTING MAGNETS N. S. Freedman (RCA, Princeton, N.J.) p 36-39 refs (See N64-19386 12-23)
11. THE THERMIONIC ENERGY CONVERTER F. G. Block (RCA, Lancaster, Pa.) and K. G. Hernqvist (RCA, Princeton, N.J.) p 40-44 (See N64-19387 12-06)

N64-19377 Radio Corp. of America, Harrison, N.J. Special Electronic Components Div.
RCA'S ROLE IN DIRECT ENERGY CONVERSION
D. W. Chace *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 2–5 (See N64-19376 12-06)

A discussion is presented of research and development in: direct energy-conversion technology, thermoelectric cooling, thermoelectric power, thermionics, solar cells, batteries, MHD, and superconducting magnets. R.T.K.

N64-19378 Radio Corp. of America, Harrison, N.J. Special Electronic Components Div.
THERMOELECTRICS FOR POWER – A LOOK AT PRODUCT ENGINEERING POTENTIALS
R. L. Klem *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 6–7 refs (See N64-19376 12-06)

A discussion is presented of the basic technical skills, the facilities, the general technology, and the materials required for thermoelectric-device development. The future of thermoelectric-energy conversion in many applications, including nuclear-reactor thermoelectric systems (such as SNAP-10A) and radioisotope thermoelectric systems, is also discussed. R.T.K.

N64-19379 Radio Corp. of America, Harrison, N.J. Special Electronic Components Div.
FOSSIL-FUEL THERMOELECTRIC GENERATORS
W. F. Lawrence and A. G. F. Dingwall *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 8–12 refs (See N64-19376 12-06)

For applications in which conventional electrical power supplies are not practical, a potential market exists for high-efficiency, reliable thermoelectric generators that utilize available low-cost fossil fuels (i.e., hydrocarbons such as propane, kerosene, etc.). The physics involved, the thermoelectric materials, the fuels, and the generator design are included. Also presented are recent developments in Si-Ge alloys and descriptions of several designs for Si-Ge thermoelectric devices. The basic conversion efficiency of Si-Ge materials was found to be in excess of 10%. R.T.K.

N64-19380 Radio Corp. of America, Harrison, N.J. Special Electronic Components Div.
THERMOELECTRICS FOR SPACE
L. J. Caprarola and W. J. Helwig *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 13–15 (See N64-19376 12-06)

The basic concepts of thermoelectric space-vehicle-power supplies are presented. The thermoelectric converter developed for the SNAP-10A system is described. Major SNAP-10A objectives are 1-year lifetime, 500-watt output, and a completely static system after orbital startup. R.T.K.

N64-19381 Radio Corp. of America, Camden, N.J. Communications Systems Div.
DESIGN AND ANALOG OF A THERMOELECTRIC REFRIGERATOR FOR THE MICROPAC COMPUTER CORE MEMORY
G. Rezek *In its* RCA, Camden, N.J. Direct Energy Conversion [1963] p 16–19 refs (See N64-19376 12-06)

This application of a thermoelectric refrigerator was made in a random-access coincident-current-driven ferrite-core memory for Micropac, a miniaturized computer using micromodules in the electronic circuitry section and designed for the U.S. Army. The core material of this memory required an environment of 20° to 55° C for optimum operation. A broad ambient range from −30° to 52° C was specified for the computer, necessitating refrigeration to stay within the upper limit. Planned and designed three years ago, this application neglects temperature-stabilized ferrite core materials, but the refrigerator has noteworthy features, and the design fulfilled the specified requirements. The thermal analysis can serve as a basis for better understanding of basic refrigeration applications. Author

N64-19382 Radio Corp. of America, Harrison, N.J. Special Electronic Components Div.
THERMOELECTRIC REFRIGERATION, HEATING, TEMPERATURE CONTROL, AND DISTILLATION
P. E. Wright *In its* RCA, Camden, N.J. Direct Energy Conversion [1963] p 20–24 refs (See N64-19376 12-06)

Thermoelectrics is unique among the various methods of direct energy conversion because of its dual nature. A thermoelectric circuit can serve as either a generator of electrical energy or as a refrigeration machine. Emphasized are thermoelectric applications other than power generation, e.g., refrigeration, heating, temperature control, dew-point sensing, and distillation. Author

N64-19383 Radio Corp. of America, Somerville, N.J. Special Electronic Components Div.
MAGNESIUM RESERVE BATTERIES
G. S. Lozier *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 25–27 (See N64-19376 12-06)

The emphasis of the battery program has been on the development of a high-performance reserve battery based on the magnesium, magnesium-perchlorate, mercuric-oxide system. This system, because of its high capacity per unit weight and volume over a wide temperature range, should find application in Arctic environments, antisubmarine-warfare sonobuoys, missiles, rescue equipment, and field communication equipment. This paper describes the basic properties of the system and its application to sonobuoys and to Arctic environment. Author

N64-19384 Radio Corp. of America, Princeton, N.J. RCA Labs.
SOLAR CELLS 1963 – A STATUS REPORT
Paul Rappaport *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 28–31 refs (See N64-19376 12-06)

The solar cell will probably continue to be the mainstay for space electrical power for the next 5 to 10 years. More than 100 satellites to date have used solar-cell power—ranging from the 5-w Vanguard (now 5 years old and still transmitting) to the 150-w Mariner that delivered electric power near Venus at 125° C. While emphasis has been on space application, the long range future for solar cells is in potential terrestrial application—a truly low-cost solar cell could have a profound effect on the economy of the emerging nations of the world. Presented here is the present state of cell development, with emphasis on the more-important problems of single-crystal devices, film-type devices, and radiation-damage effects. Author

N64-19387 Radio Corp. of America, Lancaster, Pa. Special Electronic Components Div.
THE THERMIONIC ENERGY CONVERTER
F. G. Block and K. G. Hernqvist (RCA, Princeton, N.J.) *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 40–44 (See N64-19376 12-06)

In simplest terms, the thermionic energy converter is an electron device, which converts heat directly into electricity. Specifically, it is a thermionic diode-type tube filled with cesium vapor, the construction of which requires the most advanced techniques in the art of tube manufacture. Its great potential

and the scope of its future applications make the thermionic energy converter a subject of great interest to the entire electron-tube industry. Author

N64-19415 Union Carbide Corp., Parma, Ohio Parma Research Lab.
KRYPTON FILLED THERMIONIC CONVERTER Technical Documentary Report, Jan.-Dec. 1963
G. G. Fee and R. Forman Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 89 p refs
(Contract AF 33(657)-10131)
(APL-TDR-64-28; AD-435591)

The evaluation of inert gas-filled thermionic diodes operating in the high-radiation field of a nuclear reactor is summarized. Space charge neutralization was accomplished with positive ions generated by nuclear radiation. Tested were 68 glass diodes containing Philips Impregnated Cathodes in the core of a 5-megawatt swimming pool reactor. Gases investigated included argon, krypton, and xenon over the pressure range of 1 to 200 torr. Although the design goal was 5w, the maximum power generated with these diodes was less than 0.25w. Primary reason for this low power was the inability to develop an anode with a work function of less than 2.1 ev when operated in a system containing a Philips Cathode. Experiments were conducted with low output converters ($<4\mu w$) filled with radioactive krypton. Such diodes exhibited negative resistance and could be made to oscillate anywhere in the range of 50 to 10×10^6 cycles. Author

N64-19498* Minneapolis-Honeywell Regulator Co., Boston, Mass.
ON COMPUTING OPTIMAL CONTROL WITH INEQUALITY CONSTRAINTS
Yu-Chi Ho (Harvard U.) and Piero B. Brentani Repr. from J. SIAM Control, Ser. A. v. 1, no. 3, 1963 p 319-348 refs Presented at the Symp. on Multivariable Systems Theory, SIAM, 1 Nov. 1962, Cambridge, Mass.
(NASA Contract NASr-27)

Two problems are considered: (1) optimal control problem—given (A), determine u as a function of time such that (B) is minimized subject to (C); and (2) optimal-feedback-control problem—given (A), determine u as a function of the instantaneous state x such that (B) is minimized subject to (C). R.T.K.

N64-19573* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
CHARACTERIZATION OF NICKEL-CADMIUM ELECTRODES Second Quarterly Report, 1 Oct. 1963-1 Jan. 1964
[1964] 25 p
(NASA Contract NAS5-3477)
(NASA CR-53731) OTS: $2.60 ph

Presented are an analysis and a characterization of the electrodes used in nickel-cadmium sealed cells by a comparison of detailed polarization measurements of single electrodes before and after periodic operation in selected modes of cyclic testing of cells at 0°, 25°, and 50° C. A correlation of these data provides a basis for specifying improved cells for space applications and comparing cells from various manufacturers. Construction of the control and cyclic testing equipment required for the program was completed. Electrodes for the program were electrochemically cleaned, weighed, and stamped with identification numbers. Two batches of electrodes were put through the initial characterization tests, and one cell was put on cyclic testing to investigate memory effects. The start of the remaining two sets of cyclic tests was delayed by modifications required in some of the control equipment and the need to investigate the cause of positive electrode blistering when characterized at charge and discharge rates of 1.0 amp. Author

N64-19575* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Defense Products Div.
RESEARCH AND DEVELOPMENT OF AN OPEN-CYCLE FUEL CELL SYSTEM Monthly Progress Report No. 11, 1 Mar.-31 Mar. 1963
David P. Ghere and John L. Platner [1963] 25 p refs
(NASA Contract NAS8-2696)
(NASA CR-53733) OTS $2.60 ph

Research activities are reported as follows: (1) dynamic vapor-pressure control—gas chromatograph studies, cell performance tests, eight-cell module test, component development, and cooling system; and (2) static vapor-pressure control—diffusion experiment and four-cell module test. R.T.K.

N64-19592* Yardney Electric Corp., New York, N.Y.
RESEARCH AND DEVELOPMENT STUDY OF THE SILVER-CADMIUM COUPLE FOR SPACE APPLICATION Quarterly Progress Report No. 1, 1 Jul.-30 Sep. 1963
George A. Dalin [1963] 29 p
(NASA Contract NAS5-3452)
(NASA CR-53831) OTS: $2.60 ph

Construction of special equipment is under way. Some portions are complete and already in use. Special cell design is complete; special dummies have been constructed and are cycling. Preliminary work on gas recombination has been carried out. A test chamber, which will accommodate a reference electrode and thermocouples, has been constructed. The top of the chamber is fitted with hermetic seals through which current can be passed, and with connections to gas valves and a pressure gage. Author

N64-19593* Yardney Electric Corp., New York, N.Y.
RESEARCH AND DEVELOPMENT STUDY OF THE SILVER-CADMIUM COUPLE FOR SPACE APPLICATION Quarterly Progress Report No. 2, 1 Oct.-31 Dec. 1963
Allen Charkey and G. A. Dalin [1963] 29 p ref
(NASA Contract NAS5-3452)
(NASA CR-53832) OTS: $2.60 ph

The construction of most cells is complete. Some cells have begun a series of deep cycles to determine voltage and capacity characteristics at various temperatures. Special dummy cells have completed evaluation cycling; weights and surface areas of the test electrodes were measured. Results show considerable shedding at low electrolyte concentrations and large increases in surface area. A new type of positive electrode with a highly porous sintered matrix was developed, which shows promise for operation on the argentous level. Construction of cells with palladium and lead additives for single level cycling is also near completion. Construction of automatic cycling equipment for evaluating cell performance under satellite conditions has been completed; most of this equipment is already in use. Author

N64-19611* Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center
ALKALINE BATTERY SEPARATOR STUDY Seventh Quarterly Report, 29 Dec. 1963-28 Mar. 1964
C. Garvin Oberholzer, J. B. Ockerman, and E. Weiss 21 Apr. 1964 31 p
(NASA Contract NAS5-2860)
(NASA CR-53713; ESB-7054-7) OTS: $3.60 ph

Ion-exchange membranes were made by copolymerizing various monomers with methacrylic acid in a matrix of microporous polyethylene. Other ion-exchange membranes were prepared by incorporating ion-exchange resins in a polyurethane matrix. The tests on cellophane, treated with antioxidants, were completed with the examination of a hydroquinone-treated sample. The samples of silver-treated cellophane showed reduced swelling in electrolyte (except at −26° C), moderate decreases in electrolyte absorption and retention, and virtually no change in electrical resistivity when compared with untreated cellophane. The reaction rate with dissolved Ag_2O was moderately slower than in untreated cellophane. Gelatinization of cellophane with zinc chloride slowed the reaction rate with Ag_2O to a moderate extent. Diisocyanate treatment of cellophane results in improved dimensional and chemical stability, and a moderate increase in electrical resistivity, without any marked effect on the electrolyte adsorption and retention. The reaction rate with Ag_2O is reduced, but silver diffusion remains too small to be measured. R.T.K.

N64-19612* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT OF AN OPEN-CYCLE FUEL CELL SYSTEM Seventh Quarterly Report, 1 Jan.-31 Mar. 1964
30 Apr. 1964 23 p
(NASA Contract NAS8-2696)
(NASA CR-53816) OTS: $2.60 ph

The static vapor-pressure-control studies have proceeded to the point where experimental data from the gas chromatograph tests are being compared with computer solutions of the theoretical mathematical model. Agreement between experimental and theoretical data was good on initial tests. A mock-up of a gas-cooled fuel cell system has been assembled, and initial testing has started. The initial tests have confirmed the feasibility of the approach. Fabrication of a 2,000 watt experimental fuel cell system is progressing well. Author

N64-19621* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS
E. C. Bruess 28 Feb. 1964 40 p
(NASA Order W-11252-B)
(NASA CR-53639; QE/C-64-4) OTS: $3.60 ph

The results of the characterization tests of five 20.0-ampere-hour size cells are given. The cells were capable of withstanding the vibration, mechanical shock, and acceleration requirements. Temperatures below and above 25° C imposed the primary limitations on the charge acceptance and the discharge capacity of the cells. The cells at 0° C were incapable of accepting a continuous overcharge at a rate of c/10 or higher, as the maximum on charge voltage limit of 1.55 volts/cell was reached prematurely. Charging efficiency was limited by temperature. R.T.K.

N64-19641 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
THE EFFECT OF EMITTER WORK-FUNCTION PATCHES ON THE PERFORMANCE OF CESIUM THERMIONIC CONVERTERS
John W. Gadzuk Wright-Patterson AFB, Ohio, ASD, Jun. 1963 48 p refs
(Contract AF 33(616)-7624)
(ASD-TDR-63-748; AD-420279)

An experimental program to obtain the current–voltage characteristics of a metal cesium thermionic converter with a monocrystal molybdenum emitter showing the (110) crystallographic face to cesium vapor is described, and the results are presented. It is shown that the continuous linear increase in output current with decreasing output voltage or, in other words, the fact that the emission current does not show a sharp saturation value, may be due to patches of different work function on the emitter surface. From the analysis of these characteristics, the percentage area with the exponential distribution is determined. The experimentally determined values of the patch area decrease linearly with increasing values of the ratio of emitter temperature to cesium reservoir temperature, from which it is concluded that these patches may be caused by thermal excitation of the adsorbed layer on a nonuniform substrate. Author

N64-19642 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
RATE-LIMITING STEPS ON FUEL-CELL ELECTRODES
Adrian R. Reti Wright-Patterson AFB, Ohio, ASD, Jan. 1963 82 p refs
(Contract AF 33(616)-7624)
(ASD-TDR-63-118; AD-408205)

The purpose of this investigation was to identify and to study the step or steps that limit fuel cell electrode performance. The electrodes considered were the typical porous, gaseous diffusion type, and most of the effort was directed toward acquiring a more quantitative understanding of the effect of the different variables governing electrode performance. It was found that for all of the systems studied (O_2 and H_2O_2 electroreduction, H_2 and ethylene oxidation), for a particular catalyst-electrolyte system, the electrode performance could be described as a function of reactant concentration and current density only. The most significant finding in these electrochemical kinetic studies was that for both the O_2 and the H_2 systems, in the current density range of practical interest (10^{-2} to 10^{-4} amp/cm^2) the reactant chemisorption rate on the electrode surface plays an important role in governing the electrode potential, and makes it impossible to describe the electrode performance by a simple expression such as the Tafel equation. Author

N64-19667 Radio Corp. of America, Lancaster, Pa.
THE DEVELOPMENT OF A THERMIONIC CONVERTER MODULE SUITABLE FOR LIQUID METAL HEATING [Summary Technical Report, 15 Jan. 1963-15 Feb. 1964]
G. Y. Eastman and J. J. O'Grady Wright-Patterson AFB, Ohio, AF Aero-Propulsion Lab., Mar. 1964 103 p
(Contract AF 33(657)-8005)
(APL-TDR-64-36; AD-436806)

Life testing of the A-1198B cylindrical converter, designed for operation in a liquid metal loop, established the soundness of the basic design. Operation in excess of 2400 hours was demonstrated. The design and fabrication methods perfected in the development of the A-1198B led directly to the production of a module consisting of three series-connected converters within a single vacuum-tight envelope. This module, designated the A-1274, became the first multiple-unit thermionic energy module and proved the feasibility of the modular principle. Modular techniques were further extended by the production of a 10-converter unit, a complex structure containing a large number of ceramic-to-metal and metal-to-metal seals. Author

N64-19792* Thompson Ramo Wooldridge Inc., Cleveland, Ohio TRW Electromechanical Div.
BRAYTON CYCLE CAVITY RECEIVER DEVELOPMENT Quarterly Report, Jan.-Mar. 1964

[1964] 54 p
(NASA Contract NAS3-2779)
(NASA CR-53874; ER-5905) OTS: $5.60 ph

This report covers progress in the development of the Brayton-cycle cavity receiver. Project objectives are given, design analyses are performed, and material compatibility is investigated. C.L.W.

N64-19795* Case Inst. of Tech., Cleveland, Ohio Digital Systems Lab.
ANALYSIS OF AN INCREMENTAL DIGITAL POSITIONING SERVOSYSTEM WITH DIGITAL RATE FEEDBACK
Jon Terry Beckett Feb. 1964 87 p refs
(NASA Grant NsG-36-60)
(NASA CR-53867; EDC-1-64-20) OTS: $8.10 ph

A technique is presented that may be used to measure the average rate of a series of pulses in a continuous manner. The value of this technique is demonstrated by utilizing it in an incremental digital positioning servosystem to provide first-derivative feedback. An experimental model of such a system is studied with respect to its response to a step input for various amounts of digital rate feedback. The dynamic performance is compared with the response predicted by a mathematical model of the system. It is further compared with the response of the same system in which an analog tachometer is used. Author

N64-19796* Case Inst. of Tech., Cleveland, Ohio Digital Systems Lab.
DIGITAL LEAD COMPENSATION OF PULSE-DATA CONTROL SYSTEMS
Paul H. Gaither [1963] 90 p refs
(NASA Grant NsG-36-60)
(NASA CR-53868; EDC-1-63-17) OTS: $8.10 ph

Pulse-data or incremental path control systems are feedback control systems used in many applications where the controlled variable or its derivatives must follow a given path with high accuracy. A form of digital lead compensation is developed that maintains the stability of this type of system at higher loop gains than would be possible without compensation. This improves the static and dynamic accuracy of the system. Analysis methods are used to predict the effect of this form of compensation on the performance of the system. Synthesis methods for type I second- and third-order systems are developed that permit the design of digital lead compensation units, which provide satisfactory compensation at a given loop gain. An experimental model is described. Author

N64-19798 General Motors Corp., Indianapolis, Ind. Allison Div.
DIFFUSION OF POTASSIUM IN A LIQUID METAL CELL
R. B. Wright 21 Jan. 1964 69 p refs
(EDR-3814)

Experimental work and analyses were initiated to (1) investigate diffusion properties of amalgams, and (2) evaluate the effect of diffusion rate on LMC performance. Studies were conducted to determine the diffusion coefficient of potassium in mercury–potassium amalgams at various concentrations. Sufficient data have been obtained from these studies to calculate diffusion coefficients for amalgams between 0.03 and 0.20 mole fraction potassium. Tests are being continued to include the ranges of 0 to 0.03 and 0.20 to 1 mole fraction. Analyses of diffusion characteristics have been conducted to relate electrode–electrolyte interface concentrations with bulk electrode concentrations as a function of diffusion coefficients. These analyses have been programed into a computer mathematical model. Attempts have been made to correlate the mathematical model with data obtained from laboratory cells. The mathematical model appears to be a more desirable configuration for an actual LMC system. System performance is presented for two basic cell configurations. Supplementary data regarding (1) interface concentration equation, (2) diffusion in the LMC, (3) parametric analysis of the liquid metal fuel cell, and (4) determination of diffusion coefficient are presented. Author

N64-19818 Tracor, Inc., Austin, Tex.
STUDY OF THE OXYGEN ELECTRODE MECHANISM Report No. 4 (Final), 1 Jan. 1962-31 Dec. 1963
Ray M. Hurd 13 Mar. 1964 78 p refs
(Contract DA-36-039-SC-89159; ARPA Order 247-61)
(TRACOR-64-138-U; AD-437157)

Transporting oxygen from a gas-feed stream to reaction sites at the electrode/electrolyte interface are examined. Transfer across the gas/liquid interface and through the bulk solution is well understood, and sufficient data for gas diffusion electrode design are available. A method to study the surface migration process is outlined, using double-layer capacity measurements to monitor the presence of adsorbed oxygen as a function of time on electrodes of varying geometries. The dependence of the double-layer capacity of platinum in acid and alkaline electrolytes on a variety of parameters is explored. A "reduced" platinum surface is insensitive to oxygen adsorption. These observations confirm other research suggesting the importance of a surface oxide in the behavior of the oxygen electrode. While the proposed method of examining surface migration cannot be applied to a reduced platimum surface, it is still valid for migration along a conducting oxide. Author

N64-19827 Argonne National Lab., Ill.
WHY STUDY DIRECT CONVERSION?
Bernard I. Spinrad *In its* AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 3–14 (See N64-19826 12-01) OTS: $2.75

The importance of a more efficient total use of solar energy is discussed. The ways in which increases in efficiency of energy conversion can add to energy reserves are presented. The transduction processes currently employed to convert energy to its final use, as well as some new transduction processes are reported. The importance of direct energy conversion in the exploration of space is stressed. R.T.K.

N64-19830 Wisconsin U., Madison Solar Energy Lab.
SOLAR ENERGY CONVERSION
J. A. Duffie *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 24–25 (See N64-19826 12-01) OTS: $2.75

The processes for energy conversion from solar to other energy forms are described. These processes are classified as thermal, or "photon," processes. Also discussed are the properties necessary for a system for solar–thermoelectric conversion, the radiation properties of surfaces, and the photovoltaic process for solar-energy conversion. R.T.K.

N64-19835 General Motors Corp., Indianapolis, Ind. Allison Div.
LIQUID METAL CELLS
R. E. Henderson *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 49–52 (See N64-19826 12-01) OTS: $2.75

Potassium–mercury liquid-metal cells were studied theoretically and experimentally. These cells were found to have

high heat-transfer capability and high current density and to be capable of thermal and electrical regeneration. A schematic diagram of the arrangement of the potassium–mercury cell and the results of cell operation are included. R.T.K.

N64-19836 Argonne Natl. Lab., Ill.
HYDRIDE AND BIMETALLIC REGENERATIVE EMF CELLS
M. S. Foster, C. E. Johnson, A. K. Fischer, and C. E. Crouthamel *In its* AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 53–63 refs (See N64-19826 12-01) OTS: $2.75

Two types of regenerative cells were studied—the hydride cell and bimetallic concentration cell. Current densities of about 10 amp/sq ft were achieved, using a lithium hydride cell with a 5-mil-thick Armco iron diaphragm at a cell operating temperature of 500° C. The study of bimetallic cells was restricted to cells containing three liquid phases. The current-voltage characteristics of six cells, utilizing different bimetallic combinations, were determined and are presented in tabular form. A recirculating helium atmosphere glove box, designed and constructed, is described. R.T.K.

N64-19837 IIT Research Inst., Chicago, Ill. Physics Div.
PHOTOVOLTAIC ENERGY CONVERSION AND FUEL CELL RESEARCH AT IIT RESEARCH INSTITUTE
John W. Buttrey *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 64–65 (See N64-19826 12-01) OTS: $2.75

An investigation of CdTe was made as a material for a solar-energy converter. The CdTe devices that were produced have had very low efficiencies (less than 3 percent) with a lifetime of 25 μsec; resistivity 3000 ohm-cm p type; hole mobility, 100 cm^2/volt sec; electron mobility, greater than 2000 cm^2/volt sec. A device to convert radioactive energy to electricity was devised. This device converts beta rays to light and uses a silicon photovoltaic converter to produce electricity. Fuel-cell research was concentrated in two areas. One area is the use of inorganic ion-exchange membrane for fuel cells, and the other system involves the development of cells based on methanol as the fuel. R.T.K.

N64-19838 General Motors Corp., Indianapolis, Ind. Allison Div.
GERMANIUM CELLS FOR RADIANT ENERGY CONVERSION
G. C. Jain *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 68–77 refs (See N64-19826 12-01) OTS: $2.75

A discussion is presented of: (1) the operational characteristics of a germanium solar cell; (2) the limit on power densities from germanium cells; (3) the efficiency of conversion for a black-body source operating at 2000° K; and (4) the conversion efficiency of germanium cells and silicon cells for solar energy. R.T.K.

N64-19841 Massachusetts Inst. of Tech., Cambridge
REVIEW OF MHD POWER GENERATION
W. D. Jackson *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 101–109 refs (See N64-19826 12-01) OTS: $2.75
(Partially supported by AF, ARMY, ONR, NSF)

The history of the development of MHD (magnetohydrodynamic) power generation is presented. The feature that distinguishes MHD generators from other energy-conversion devices is that a body force, rather than a surface force or effect, is involved in the basic conversion process. Work on MHD power generation was initially directed toward the development of large-scale central installations using fossil fuel and open-cycle operation. A simplified diagram of a fossil-fuel MHD system is included. Future applications of MHD generators are also discussed. The development of high-temperature nuclear reactors has reached the point to where it is worthwhile considering the possibility of coupling an MHD generator to a nuclear heat source for central power generation and, accordingly, to achieve thermal efficiencies considerably in excess of those available from nuclear-steam turbine installations. The generation of electrical power from a space-vehicle nuclear heat source offers a further potential application for MHD generators. R.T.K.

N64-19843 General Motors Corp., Indianapolis, Ind. Allison Div.
EXPERIMENTAL DATA FOR ANALYSIS OF THERMIONIC CONVERTERS
D. L. Dresser *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 126–143 refs (See N64-19826 12-01) OTS: $2.75
(Partially supported by AFSC)

Typical low-temperature and typical high-temperature current-voltage characteristics are given for a tantalum emitter. Various tools that are potentially useful for analysis of the converter are described; among these are the oscillogram and the spectrograph. The current-voltage characteristics were obtained on a planar molybdenum emitter and a slotted tantalum emitter. An analysis of typical data obtained from these emitters is included. R.T.K.

N64-19844 Illinois U., Urbana
EXTENDED SURFACE THERMIONIC CONVERTERS
S. L. Soo and S. G. Quintella *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 144–151 refs (See N64-19826 12-01) OTS: $2.75

The reduced efficiency and the increased output obtained by increasing the electrode size in a thermionic system are estimated. Data on the effect of the geometry of the fins constituting the system on the output and efficiency are included. R.T.K.

N64-19845 Argonne Natl. Lab., Ill.
THERMIONIC ENERGY CONVERSION FOR DC AND HIGH FREQUENCY POWER OUTPUT
Hans K. Richards *In its* AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 152–160 (See N64-19826 12-01) OTS: $2.75

Experiments were conducted with cesium and potassium cells. Emitter-collector distances, emitter temperatures, and cesium or potassium densities were varied. Graphs and tables are presented that show the effects of varying these parameters. R.T.K.

N64-19846 Battelle Memorial Inst., Columbus, Ohio
EVALUATING POWER SOURCES
J. Mc Callum *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 163–165 (See N64-19826 12-01) OTS: $2.75

A list of 10 characteristics most commonly important concerning electrical power sources, together with measuring dimensions, is given to illustrate the need for a common yardstick for the purpose of comparing one power source with another. These characteristics are size, weight, cost, temperature, rate, life, quality of power, reliability, efficiency, and convenience. R.T.K.

N64-19849 Argonne Natl. Lab., Ill.
THE LIQUID METAL LINEAR GENERATOR
E. S. Sowa *In its* AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 181–185 refs (See N64-19826 12-01) OTS: $2.75

The possibility of producing reactor cores to operate at temperatures in the range 1,000° to 1,100° C is considered. At such temperatures, the physical properties of liquid metals make the operation of vapor cycles possible. If the vapor cycle is applied to producing motion in a liquid-metal stream, the moving liquid metal can be passed directly through a magnetic field where electrical energy can be extracted. As an example, the vapor pressure of sodium is plotted as a function of absolute temperature. An MHD circuit used to produce the vapor, which is led to an expanding nozzle in a jet pump or injector, is described. R.T.K.

N64-19872 Bright Star Industries, Clifton, N.J.
MAGNESIUM FLAT CELL BATTERIES Final Report, 30 Sep. 1958-30 Oct. 1963
R. A. Pette [1963] 77 p
(Contract DA-36-039-SC-78231)
(AD-428461)

Development of an Mg-$MgBr_2$-MnO_2 flat cell battery was undertaken. Areas of investigation that received special attention were conductive coating of magnesium alloys, cathode mix formulations, duplex electrode, and cell assembly techniques. Increased capacity was obtained through adequate venting of hydrogen gas and proper choice of sealing materials. Capacity data on the effects of various parameters studied were obtained. Author

N64-19894 Atomics International, Canoga Park, Calif.
OPTICAL, LIGHTING, AND PHOTOGRAPHIC EQUIPMENT FOR THE SRE RECOVERY PROGRAM
E. R. Meise 15 Apr. 1964 53 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-6387) OTS: $1.25

Presented is a general description with pictures of the numerous optical devices, special lights, and photographic equipment that were used in the successful moderator and fuel replacement program at the Sodium Reactor Experiment (SRE). The optical devices, designed to operate at 400° F, were gas tight, and varied in length from 3 to 30 ft. Author

N64-19925* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS. GENERAL PERFORMANCE TEST OF GENERAL ELECTRIC COMPANY 12.0 AMPERE HOUR CELLS
E. C. Bruess 8 Apr. 1964 40 p refs
(NASA Order W-11252-B)
(NASA CR-53923; QE/C-64-6) OTS: $3.60 ph

The object of this evaluation program was to gather specific information concerning sealed nickel cadmium cells designed for use in spacecraft. Information concerning the performance characteristics and limitations, including cycle life under various electrical and environmental conditions, is of interest to power system designers and users. Cell weaknesses, including causes of failure of present designs, are of interest to suppliers as a guide to product improvement. A total of 1,100 cells was purchased by NASA from four manufacturers, and consiated of seven sample classifications ranging from 3 to 20 amp hr. The program consisted of acceptance tests, general performance tests, and cycle life tests. The results of the characterization tests of five 12-amp-size cells are given. Author

N64-19975 Denver Research Inst., Colo.
INVESTIGATION OF THE CHARACTERISTICS OF INTERMETALLIC COMPOUNDS AS THERMIONIC EMITTERS Final Technical Summary Report [Nov. 1, 1961-Oct. 31, 1963]
C. B. Magee, M. J. Pool, W. D. Mc Mullen, R. C. Jerner, and R. H. Cox 31 Dec. 1963 59 p refs
(Contract Nonr-3361(01))
(DRI-2137; AD-428591)

The evaporation rates of 12 intermetallic transition-metal beryllides were obtained in the temperature range from 900° to 1,200° C by means of the Langmuir free evaporation technique. Assuming the evaporating species to be monatomic beryllium, vapor pressures were calculated from evaporation rates, and van't Hoff plots were made. Although the beryllides have much lower evaporation rates than beryllium, the material loss is still large enough to preclude their use as emitter materials at elevated temperatures. Crystal structure models of the beryllides were constructed to aid in interpreting the evaporation process. Gravimetric, X-ray, and metallographic techniques were used to determine the reactivity of zirconium, niobium, and tantalum beryllides with cesium vapor. Specimens were exposed to cesium vapor. Specimens were exposed to cesium pressures of from 1 to 2 mm of mercury for 48 hours at 900° C. Beryllium depletion at the sample surfaces and microcracks, both perpendicular to and parallel with the surface, were observed. A high vacuum stainless steel diode was designed and constructed. Emission currents were measured using beryllium and tungsten as emitters. Author

N64-19999* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio New Product Research
BRAYTON CYCLE SOLAR COLLECTOR DESIGN STUDY PROGRAM, ITEM II, A Monthly Progress Report No. 5, Dec. 1, 1963-Dec. 31, 1963
13 Jan. 1964 7 p
(NASA Contract NAS3-2789)
(NASA CR-53504) OTS: $1.10 ph

A design was recommended for a Brayton-cycle concentrator after a technical review of the program. Detailed design, fabrication, and handling are discussed. Micrometeoroid erosion specimens were delivered, and the erosion experiment parameters were recommended. R.T.K.

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-19438 Joint Publications Research Service, Washington, D.C.
THE THEORY OF SPIRAL-TO-BALL TRANSITIONS IN BIOPOLYMERS
B. A. Fedorov, T. M. Birshteyn, and O. B. Ptitsyn *In its* Biophys. Studies on Polymers, Nucleic Acids, and Brain Neurons 21 Apr. 1964 p 1–11 refs (See N64-19437 12-16) OTS: $1.00

A formula has been obtained for the angular dependence of the intensity of light and X-ray scattering by a biopolymer macromolecule in the spiral-to-ball transition region. It has been shown that the scattering indicatrix has inflections the

position of which makes it possible to determine the number and length of segments in each ball-shaped part of the molecule, and also the number and length of the rods modeling the spiral sections of the chain. Author

N64-19464 California U., Berkeley. Lawrence Radiation Lab.
THE PURIFICATION OF CARBOXYDISMUTASE
P. W. Trown *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 1–5 refs (See N64-19463 12-01) OTS: $0.75

Carboxydismutase is reversibly inhibited, protected by sulfate ions, and by phosphate at pH 7.6. The inhibition by sulfate is competitive with RuDP, but that by phosphate is complex and not subject to definition in competitive or noncompetitive terms. Gel filtration on Sephadex G-200, with a high-ionic-strength eluent containing a high concentration of sulfate ion, as well as reduced glutathione and Versenol, led to a considerable purification of carboxydismutase. The resulting enzyme preparation was at least 95% pure and highly active. Author

N64-19466 California U., Berkeley. Lawrence Radiation Lab.
THE RADIATION-INDUCED REACTION OF THYMINE WITH ETHANOL IN DEAERATED AQUEOUS SOLUTIONS
Joan Friedman *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 11–12 refs (See N64-19463 12-01) OTS: $0.75

An attempt was made to irradiate thymine, in the presence of benzophenone, with gamma rays. The reaction was carried out in a mixed solvent of water and ethanol. The solutions studied were degassed to avoid formation of hydroperoxides. Approximately 70% of the thymine initially present yielded two products, neither of which was the starting material, and the formation of which was not dependent on benzophenone but on ethanol. Further experiments using ^{14}C-labeled ethanol and unlabeled thymine showed both products contained the ethanol moiety as well as the thymine moiety. A.W.

N64-19467 California U., Berkeley. Lawrence Radiation Lab.
SOME CHEMICAL ATTEMPTS TO SUPPORT AN OXIDATIVE PHOSPHORYLATION MECHANISM
Peter M. Scott *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 13–14 refs (See N64-19463 12-01) OTS: $0.75

The failure of chromanyl phosphate to exist in equilibrium with a hydroquinone phosphate was established by the observance of a lack of deuterium exchange in the 3 position of the heterocyclic ring with the use of a suitable deuterated solvent. Similarly, there was no exchange with the di-sodium salt of the chromanyl phosphate in D_2O at pH 8.5 (approx). No deuterium exchange was observed at the methyl group or with duroquinone. A.W.

N64-19468 California U., Berkeley. Lawrence Radiation Lab.
CHANGES IN CONCENTRATIONS OF ^{14}C-LABELED COMPOUNDS IN PHOTOSYNTHESIZING CHLORELLA CAUSED BY ADDITION OF IODOACETIC ACID
Roger Hiller and J. A. Bassham *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 15–17 refs (See N64-19463 12-01) OTS: $0.75

Studies were made of a class of inhibitors that might reproduce the effects of lipoic acids in the concentrations of intermediate compounds of the photosynthetic carbon-reduction cycle. Iodoacetic acid (IAA) was chosen. In the experiment, the only observable site of carbon-cycle inhibition was triose-phosphate dehydrogenase. The continued production of RuDP after addition of the inhibitor points to continued photosynthetic ATP production. It should therefore be possible to restore, to some extent, photosynthetic O_2 production in the presence of IAA by addition of nonphosphorylated compounds more oxidized than 3-phosphoglyceric acid (PGA). A.W.

N64-19469 California U., Berkeley. Lawrence Radiation Lab.
THE EFFECTS OF LIPOIC ACID ON THE REDUCTION OF CARBON DIOXIDE DURING PHOTOSYNTHESIS
J. A. Bassham, Frances Edmonston, and Martha Kirk *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 18–19 refs (See N64-19463 12-01) OTS: $0.75

Iodoacetic acid effects are different from those of lipoic acid on the reduction of carbon dioxide during photosynthesis, and suggest that the lipoic acid effect must be specific to disulfhydryl reagents and must produce a different type of inhibition. The effects of inhibitors that interfere with primary photochemical production of ATP and reduce cofactors are also different from those of methyl lipoic and lipoic acids, and resemble the effects of turning off the light, producing increase in PGA and decrease in the levels of sugar phosphates. Thus, the effects of methyl lipoic and lipoic acids cannot as yet be related to effects of other known inhibitors. A.W.

N64-19500* Arizona U., Tucson
CHEMISORPTION DETECTOR FOR OXYGEN
Donald J. Collins and Stuart A. Hoenig Repr. from Rev. Sci. Instr. v. 35, no. 1, 15–16 Jan. 1964 p 15–16 refs
(NASA Grant NsG-458)

A chemisorption detector for oxygen has been developed. The device depends upon the increase in work function of a tungsten filament when chemisorption of oxygen occurs. The device is sufficiently sensitive to detect oxygen at pressures of 10^{-11} torr and is insensitive to nitrogen for nitrogen-to-oxygen ratios of up to $N_2/O_2 \approx 10/1$. Author

N64-19588* Florida State U., Tallahassee Inst. for Space Biosciences
THERMAL SYNTHESIS OF NATURAL AMINO-ACIDS FROM A POSTULATED PRIMITIVE TERRESTRIAL ATMOSPHERE
Kaoru Harada and Sidney W. Fox Repr. from Nature, v. 201, no. 4917, 1964 p 335–336 refs
(NASA Grant NsG-173-62)

In order to synthesize amino acids thermally, methane was passed through aqueous ammoniacal solution and heated in a subsequent passage through one of several solids such as exist in the crust of the earth. In a typical experiment, methane was bubbled through 14 *N* ammonium hydroxide, and the mixed gas was further passed through a solid silica gel, quartz sand, volcanic sand, or alumina in a Vycor glass reaction tube heated from 900° to 1,100° C with the thermocouple of the pyrometer inserted in the solid. The reacted gas was absorbed in 3 *N* aqueous ammonia in the cold. The ammoniacal solution was then heated in a sealed bottle at 75° C for 35 hours. Ammonia and water were evaporated under reduced pressure, and the residue was refluxed with 4 *N* hydrochloric acid for 5 hours. The hydrolysate was evaporated to dryness under reduced pressure; the residue was dissolved in pH 2.2 citrate buffer, and the solution was analyzed on a Phoenix K-5000 automatic amino-acid analyzer. Typical results of the syntheses and analyses are presented in tabular form. Simple gases were found to be thermally convertible to most of the amino acids common to protein in a way that is sequentially compatible with other aspects of the thermal theory of biochemical origins. R.T.K.

N64-19589* Florida State U., Tallahassee Inst. for Space Biosciences

STEREOSPECIFIC SYNTHESIS OF AN OPTICALLY ACTIVE α-AMINO ACID

Kaoru Harada and Sidney W. Fox Repr. from Naturwiss. (Berlin) [1962] 2 p refs

(NASA Grant NsG-173-62)

(*Its* Contrib. 23)

A new method of synthesis of optically active α-amino acids in solution is described. The synthesis described can be regarded as a model for the formation of optically active amino acid on the primitive earth, although the specific amine employed for stereospecific synthesis is not a plausible prebiological compound. This type of phenomenon is under further investigation in connection with the Strecker synthesis. R.T.K.

N64-19758 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SYNTHESIS OF POLYMERIC POLYDIOXYARYLENEPHOSPHONITRYLATES

S. M. Zhivukhin, V. B. Tolstoguzov and V. V. Kireyev 17 Feb. 1964 13 p refs Transl. into ENGLISH from Plasticheskie Massy (USSR), no. 7, 1963 p 24–28

(FTD-TT-63-1101/1+2+4; AD-433578)

Polydioxyarylenephosphonitrylates can be synthesized in three different ways: by condensation of phosphonitrylchlorides with diatomic phenols or with their phenolates, by exchange of esters between alkoxyphosphonitrylates, or by the reaction of alkoxyphosphonitrylchlorides and diatomic phenols. The conditions under which these processes occur and the effect of various factors on the formation and structure of the polymers obtained have been studied. The structure and properties of these polymers and the methods of modifying them have been studied, and the ways of using them have been indicated.

Author

N64-19791 AiResearch Mfg. Co., Los Angeles, Calif.

INVESTIGATION OF INTEGRATED CARBON DIOXIDE HYDROGENATION SYSTEMS Technical Documentary Report, 1 Aug.–15 Dec. 1962

R. F. Rydelek and G. Christensen Wright-Patterson AFB, Ohio, ASD, Aug. 1963 54 p

(Contract AF 33(657)-8953)

(ASD-TDR-62-581, Pt. II)

An integrated recovery system was studied in which atmospheric carbon dioxide was removed by adsorption in a molecular-sieve bed, desorbed, mixed with hydrogen, and transferred to a reactor for hydrogenation to methane and water over a nickel-kieselguhr catalyst. Of the several modes of desorption studied, internal heating of the molecular-sieve adsorption bed was the most efficient. Carbon dioxide was desorbed at a steady, controllable rate. System efficiencies of 97% to 100% were attained. A self-controlling desorption system was developed in which the carbon dioxide output was detected by an infrared analyzer that in turn controlled the rate of molecular-sieve-bed heating. A system combining the adsorptive and catalytic functions was studied to determine the feasibility of single-bed operation. Although investigation showed that this approach was feasible, a comparative analysis indicated that the single-bed unit would be less efficient and less advantageous than the dual-bed system tested. A comparative analysis of the dual-bed and single-bed systems is given. Author

N64-19810 National Bureau of Standards, Washington, D.C.

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE. VOLUME NO. 1, JANUARY, FEBRUARY, MARCH 1964

J. J. Diamond ed. 1964 69 p 109 refs

This bibliography covers the following subjects: (1) devices for achieving temperatures above 1,500° C; (2) devices for measuring and controlling temperatures above 1,500° C; (3) devices for physical measurements at temperatures above 1,000° C; (4) properties, at temperatures below and above 1,000° C, of materials that melt above 1,500° C—metallic materials, nonmetallic materials, and mixed materials; (5) properties, at temperatures above 1,000° C, of materials that melt below 1,500° C; (6) phase equilibria; and (7) reactions at temperatures above 1,000° C. R.T.K.

N64-19811 California U., Berkeley

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS

L. Brewer, comp. 31 Mar. 1964 21 p 70 refs

(Rept. 11)

This bibliography includes the following topics: (1) reaction between gases and condensed phases; and (2) spectroscopy of interest to high-temperature chemistry. R.T.K.

N64-19819 Tracor, Inc., Austin, Tex.

ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 4, 1 Oct.–31 Dec. 1963

Earl S. Snavely, Jr., Larry D. Fiel, Larry G. Spears, and Wallace E. Harrell, Jr. 31 Mar. 1964 33 p refs

(Contract Nonr-4054(00); ARPA Order 399)

(TRACOR-64-154-U; AD-436762)

This report describes work that has been devoted to the development of suitable reference and working electrodes for use in electrochemical fluorination studies in anhydrous HF. Of several metal–metal fluoride combinations studied, including nickel, platinum, aluminum, and mercury as possible reference electrodes, the Hg/Hg_2F_2 is far superior with regard to reproducibility, stability, and reversibility and will be used in all future studies. Investigations of possible working electrodes have involved aluminum, platinum, thallium, magnesium, and iron. Thallium corroded very rapidly in anhydrous HF. Iron and platinum corrode less rapidly than thallium but yield very erratic anodic polarization curves with a high corrosion current. Aluminum and magnesium corrode very slightly, if any, after an initial period of dissolution that lasts about 5 hours in anhydrous HF. The aluminum acquires a highly resistive protective film, presumably AlF_3. Cathodic treatment destroys this film and initiates a rapid attack of the aluminum. Author

N64-19823* Georgia Inst. of Tech., Atlanta Engineering Experiment Station

CHEMICAL REACTIVITY OF HYDROGEN, NITROGEN AND OXYGEN ATOMS AT TEMPERATURES BELOW 100°K. Second Semiannual Technical Report

Henry A. Mc Gee, Jr. 1 Mar. 1964 46 p refs

(NASA Grant NsG-337)

(NASA CR-53883) OTS: $4.60 ph

The current status of research in the following areas is reported: (1) ionization and its appearance-potential measurements; (2) cryogenic purification and mass-spectrometer inlet system; (3) manipulative techniques in low-temperature chemistry; (4) trapping of species generated by pyrolysis; (5) reactivity of atomic hydrogen; and (6) krypton fluorides. R.T.K.

N64-19851 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services

POLYORGANIC METAL SILOXANES AND POLYORGANIC SILOXY METAL OXANES [POLIORGANOMETALLOSILOKSANY I POLIORGANOSILOKSIMETALLOKSANY]

A. A. Zhdanov and K. A. Andrianov Apr. 1964 6 p refs Transl. into ENGLISH from Khim. i Prikl. Prim. Kremneorg. Soedin., Tr. Konf., Leningrad, 1958 p 100–105
(TIL/T-5502)

Experiments confirm that other elements than C and Si can form polymer chains. Ti, Al, Co, Ni, and others can be used to synthesize polymers in which the metal molecule skeletons can be framed with organic substances to give a wide range of properties. Author

N64-19864 Monsanto Research Corp., Dayton, Ohio Dayton Lab.
STUDIES OF LOW TEMPERATURE OXIDATION REACTIONS First Annual Progress Report, 1 Oct. 1962-30 Sep. 1963
L. Parts and John T. Miller, Jr. [1963] 47 p refs
(Contract Nonr 3977(00))
(AD-427996)

Autoxidation of methylboranes and of diborane was investigated at cryogenic temperatures in solution. Trimethylborane was the only compound susceptible to oxidation, yielding a coordination polymer. Depolymerization to the monomeric dimethylborylmethylperoxide occurs at very low temperatures. The mechanism of oxidation is discussed. Nitrosyl nitrate, a metastable isomer of dinitrogen tetroxide, was unexpectedly reactive toward some diolefins. Dinitro compounds and nitroso nitrates are formed even at −196° C. A low temperature infrared cell, incorporating a horizontal sample compartment, and utilizing a vertical optical beam, was designed and constructed to be used for in situ spectroscopic investigation of reactions at low temperatures. The vacuum line work on the oxidation of methylboranes was completed, and the results are incorporated in the report in the form of a manuscript for publication. Work on oxidative nitration, and in low-temperature spectroscopy is continuing, and the accomplishments to date are presented as a descriptive discussion. Author

N64-19910 Oak Ridge National Lab., Tenn.
REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1964
W. R. Grimes et al May 1964 279 p refs
(Contract W-7405-ENG-26)
(ORNL-3591) OTS: $3.50

This report covers molten-salt reactors, aqueous reactors, gas-cooled reactors, and other areas associated with the development of nuclear reactors. Some of the specific areas included are high-temperature phase equilibrium studies, radiation chemistry of molten-salt-reactor systems, chemical studies in molten salts, chemistry of pressurized-water-reactor systems, chemical support for high-flux reactors, mechanisms of corrosion of zirconium alloys, physical chemistry of high-temperature aqueous systems, interaction of water with particulate solids, diffusion processes, reactivity of graphite and of fueled graphite spheres with oxidizing gases, irradiation behavior of high-temperature fuel materials, fission gas release from single-crystal uranium oxide, effect of radiation on ceramic materials, fission products released by nonnuclear heating of fuel materials, fission products released during in-pile destruction of reactor fuels, corrosion studies for chemical reprocessing plants, chemical support for saline-water program, the chemistry of hydrogen–sodium–potassium systems, and the effects of radiation and heat on organic materials. C.L.W.

N64-19914 Du Pont De Nemours (E. I.) and Co., Aiken, S.C. Savannah River Labs.
REMOVAL OF CESIUM FROM EVAPORATOR CONDENSATE
William E. Prout and Edwin R. Russell Mar. 1964 17 p
(Contract AT(07-2)-1)
(DP-876) OTS: $0.50

An ion exchange process was developed to remove cesium from condensate solutions produced when aged highly radioactive waste solutions are evaporated at the Savannah River Plant. The cesium is removed from the condensate in a single pass through a fixed bed of Decalso, an aluminosilicate gel. In laboratory tests with actual condensate, about 99% of the cesium was removed from 10,000 bed volumes of feed before regeneration of the bed was required. Author

N64-19923 Research Triangle Inst., Durham, N.C. Measurement and Controls Lab.
A RADIO-RELEASE TECHNIQUE FOR THE MEASUREMENT OF MOISTURE IN GASES Final Report
Harold G. Richter and Arthur S. Gillespie, Jr. Washington, AEC, 31 Jan. 1964 15 p refs
(Contract AT(40-1)-2513)
(ORO-591) OTS: $0.50

A radio-release procedure for the determination of minute quantities of water vapor in gases was investigated. The gas containing water vapor was passed through a column of radioactive calcium carbide ($CaC_2{}^{14}$). The acetylene ($C_2{}^{14}H_2$) generated from the chemical reaction then passed over a Geiger–Müller counter whereupon the count rate was a direct measure of the water vapor content of the original gas. The ultimate sensitivity of the reaction assuming a 1% counting efficiency, a counting cell of 1 ml volume, and the highest specific activity $CaC_2{}^{14}$ available being 10 mc/millimole, was calculated to be about 0.4μ partial pressure of water vapor in the gas. This sensitivity was not achieved because the $CaC_2{}^{14}$ contained gross amounts of unreacted calcium and barium metal impurities, together with an unknown amount of CaO and $Ca(OH)_2$. Whereas the buildup of $Ca(OH)_2$ surface coating can probably be overcome, the problem of preparation of pure $CaC_2{}^{14}$ is a serious one. Therefore, the research was stopped. Author

N64-19953* Florida State U., Tallahassee Inst. for Space Biosciences
THERMAL POLYMERIZATIONS OF AMINO-ACIDS AND PRODUCTION OF FORMED MICROPARTICLES ON LAVA
Sidney W. Fox Repr. from NATURE, v. 201, no. 437, 25 Jan. 1964 p 336 refs
(NASA Grant NsG-173-62)
(*Its* Contrib. 21)

To prove the thermal theory of biochemical origins, a model of a hot, dry lava field was selected for the experimentation. Amino acid mixture A (2.2 g) was placed in a depression on a 220-g sample of lava and heated for 3 to 4 hours at 170° C in an oven set in the open air of the laboratory. To simulate the effect of tidal washes or rain on hot lava, the sample was washed with approximately 20 ml of boiling bacteria-free 1.0% sodium chloride solution or with hot bacteria-free water. The resulting microspheres were mostly in the size range of 0.9μ to 1.1μ, with a few ranging to 4μ in diameter. Field observations were also made, and these and the laboratory experiments demonstrated the possibility that amino acids might be formed in a thermal continuum in a volcanic zone. Interpretation assumes that amino acids were present prior to life on the globe. A.W.

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-19353* Stanford Research Inst., Menlo Park, Calif.
A MATHEMATICAL STUDY OF IMAGE ANALYSIS Final Report
A. R. Tobey and R. O. Duda (APL) Mar. 1964 67 p refs
(NASA Contract NAS7-100; JPL Contract 950687; SRI Proj. 4621)
(NASA CR-53738) OTS: $6.60 ph

This report gives the results of an experimental study of the use of feature detection for television bandwidth compression. The goal is to determine from a set of patterns a set of simpler patterns, or features, so that each of the original patterns can be formed, at least approximately, by superposing the features. Four algorithms for determining features from patterns are described, and the results of experiments using these algorithms are compared and evaluated. Author

N64-19404 Illinois U., Urbana Coordinated Science Lab.
MINIMIZATION OF ATMOSPHERIC TURBULENCE EFFECTS ON HIGH-RESOLUTION SYNTHETIC APERTURE SYSTEMS
Dale M. Diamond Sep. 1963 69 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-179; AD-426965)

A method of processing the received signals in a synthetic aperture radar system to remove the effects of atmospheric turbulence is proposed. An appropriate mathematical model of the synthetic system and the manner in which it is affected by atmospheric turbulence is developed. The model thus developed is used as the basis for a processing procedure that matches the first few terms of a Fourier series to the phase error effect caused by the atmospheric turbulence. Several examples of a computer simulation are used to illustrate the results of such processing. Author

N64-19416 Centro Radioelettrico Sperimentale G. Marconi, Rome (Italy)
BACKSCATTER OF RADIO WAVES FROM GROUND AND SEA Technical Report [No. 1]
I. Ranzi 31 Jan. 1964 10 p refs
(Contract AF 61(052)-665)
(AFCRL-64-108; AD-434680)

The importance of F_2 irregularities in determining shape and intensity of the backscattered echoes, and its influence on the skip distance measurements by the backscatter technique, are presented. The backscatter sounding is a powerful means for the study of the distribution of the irregularities in a large zone around the sounding station. The results of a first series of radiometer recordings on 31.5 mc near Rome (Italy), are also reported. Author

N64-19485 Weapons Research Establishment (Australia)
THE DESIGN OF A NEW DOPPLER RECEIVER
J. A. Williamson Apr. 1963 35 p refs
(WRE-TN-EID-67)

A new receiver has been designed to improve missile velocity measurements. The receiver combines the signal from the missile with a fixed reference signal to extract the Doppler shift. It is proposed to add a new facility (not now in use) in the form of a pedestal frequency, to be added to the Doppler shift to avoid frequency nulls as the Doppler frequency passes through zero when changing sign. This paper describes the valve version of the receiver and outlines design problems and solutions. A transistorized version is being worked on. Author

N64-19499 Kansas U., Lawrence
THEORY OF RADAR SCATTER FROM ROUGH SURFACES, BISTATIC AND MONOSTATIC, WITH APPLICATION TO LUNAR RADAR RETURN
A. K. Fung Repr. from J. Geophys. Res., v. 69, no. 6, 15 Mar. 1964 p 1063–1073 refs

Presented is a theoretical expression for the bistatic radar return without neglecting terms involving partial derivatives of the surface. A better method of evaluating the integrals involved is shown in which no approximation needs to be made of the autocorrelation function. The final results are specialized for backscatter cases to permit comparisons with the lunar radar observations. They appear to fit the lunar observations over a wider range of angles than previous theories. Author

N64-19594* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-26, VOLUME III, FOR THE PERIOD JANUARY 1, 1963 TO FEBRUARY 29, 1964. THE DEEP SPACE INSTRUMENTATION FACILITY
31 Mar. 1964 84 p refs
(NASA Contract NAS7-100)
(NASA CR-53833; JPL-SPS-37-26, Vol. III) OTS: $8.10 ph

Activities are reported in the following areas: (1) tracking station operations—Ranger VI; (2) engineering developments—systems engineering, tracking data-monitoring program, pointing errors due to quadripod leg distortions of new truss-type quadripod at Echo station, and Mariner C 100-kw transmitter; (3) research and development—ground antennas, planetary radar project, ranging and tracking system development, RF signal generation and control, S-band implementation, and the Mesa antenna range; and (4) the 210-ft advanced antenna system. R.T.K.

N64-19629 Northrop Corp., Needham, Mass. Nortronics Div.
RADIOMETRIC DATA GATHERING PROGRAM Final Report
Apr. 1964 34 p refs
(Contract AF 19(628)-2749)
(MED-64-30; AFCRL-64-170; AD-437134)

The results are presented of an L-Band (1420 mc) measurement program undertaken to establish the radiometric temperature of materials as a function of incidence angle, polarization, and environmental conditions. Wood, asphalt, concrete, and sand were tested. Values of radiometric temperature are a decreasing function of incidence angle as measured from the nadir for the sense of polarization with the E-vector horizontal. Concrete ranges from 171° K at 20° from the nadir to 50° K at 70° from the nadir, and asphalt 201° K to 45° K at the same points. Wood and sand lie between these two values. The response characteristic for all materials exhibits the same general shape. Measured values are also given for the orthogonal polarization. The values given for concrete are 141°, 174°, and 126° K at nadir angles of 20°, 50°, and 70°, respectively. The values obtained for other materials lie close to those of concrete at the low values of nadir angles, but diverge widely at the 70° nadir angle. Water on the surface of the materials reduces the apparent temperature of the material, and snow raises it. Author

N64-19644 New York U., N.Y. Coll. of Engineering
THEORETICAL STUDY OF THE USE OF GEOMETRIC TECHNIQUES IN THE MICROWAVE FIELD Final Report, 16 Jan. 1961-15 Jan. 1964
D. J. R. Stock and L. J. Kaplan 1964 35 p refs
(Contract AF 19(604)-7486)
(AFCRL-64-129; Tech. Rept. 400-89; AD-436277)

Work on extending geometric–algebraic techniques to the representation of active and passive multiport networks as well as multimode structures is summarized. The equivalent circuits and applicable measurement techniques developed in the course of the work are mentioned. Appendices report on a class of pseudo-lossless networks, geometric properties of certain special 2-port and 2n-port transformations, voltage continuity for certain symmetrical 2n-ports, and symmetry considerations for lossless reciprocal 2n-ports. Author

N64-19646 Air Force Cambridge Research Labs., Bedford, Mass. Meteorological Development Lab.
EVALUATION OF MODIFICATION TO ANTENNA OF RAWIN SET AN/GMD-2 Research Note
Konstantins Pocs Jan. 1963 22 p refs
(AFCRL-63-211; *Its* Instrum. for Geophys. and Astrophys. 25; AD-298980)

An evaluation test was performed to determine the effect on tracking accuracy of adding power modulation to Rawin Set AN/GMD-2. It is concluded that the modification does not provide adequate protection against sensitivity to ground reflections. Author

N64-19672 Alaska U., College Geophysical Inst.
RESEARCH ON RADIO-WAVE INTERACTION IN ALASKA Final Report
W. L. Flock Jan. 1964 22 p
(Contract AF 19(604)-8833; Contract DASA-Web-07.007)
(UAGR-148; AFCRL-64-61; AD-437327)

In radio-wave interaction studies in Alaska, cosmic noise was used instead of a wanted wave of local origin. Collision frequency values obtained agree with the equation $\nu = 8.40 \times 10^7 p(\text{mm Hg})$, based on laboratory studies by Pack and Phelps. The available theories are unable to explain the values of cross modulation observed. The results are more nearly explained by Huxley's theory of 1953 than by Bailey and Martyn's theory of 1934. Tests employing separate antenna arrays for the disturbing wave and for the wanted wave are needed to more completely evaluate the capability of the technique. Author

N64-19685 National Bureau of Standards, Boulder, Colo.
ON THE PROPAGATION OF LONG WAVELENGTH TERRESTRIAL RADIO WAVES – TWO THEORETICAL TECHNIQUES
J. R. Johler and L. A. Berry *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 101–129 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7
(NAVY Order NAONR-46-59)

A multiplicity of waves or modes of electrical vibration propagate in the space between a terrestrial sphere and a concentric isotropic plasma reflector. Such a theoretical model is used to represent the earth and the ionosphere, and the propagation for such a model can be treated theoretically at frequencies less than approximately 50 kc by a direct summation of the classical series of zonal harmonics. An alternate method is found by summing the residues at the poles in the complex plane of integration of a contour integral, a procedure known as the Watson transformation. This alternate solution to the problem is exactly equivalent to the series of zonal harmonics by the theory of functions of the complex variable. Author

N64-19686 National Bureau of Standards, Boulder, Colo.
OBLIQUE INCIDENCE PULSE MEASUREMENTS AT 100 KC/S
Robert H. Doherty *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 133–148 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Fast rising pulses propagated over long ranges have provided a means for separating the ground-wave and various order sky-wave time modes at 100 kc. Amplitude and phase measurements of the once reflected sky wave show that besides the normal phase variations other phenomena occur. For example, large amplitude variations are not accompanied by phase variation; phase delays may differ for opposite directions of propagation along the same path; the attenuation rate of the signals increases with latitude; small solar flares may produce phase advances or retardations; and the amplitude variations of different time modes are uncorrelated. The observed phenomena are interpreted as further evidence of the existence of a low-altitude low-electron density region in the ionosphere. Author

N64-19687 Defence Research Board, Ottawa (Canada) Defence Res. Telecommun. Estab.
THE OBLIQUE REFLECTION OF CW LOW-FREQUENCY RADIO WAVES FROM THE IONOSPHERE
J. S. Belrose *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 149–165 ref (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

In this paper some measurements made on waves of low and very low frequency reflected from the ionosphere at oblique incidence are discussed, specifically, the amplitude and phase variations of waves propagated over distances up to 2,500 km over middle- to high-latitude paths. Both normal and abnormal propagation phenomena (such as SID's, PCD's, ionospheric storms, and nocturnal anomalies) are summarized. Author

N64-19694 Colorado U., Boulder
THE MODE THEORY OF V.L.F. RADIO PROPAGATION FOR A SPHERICAL EARTH AND CONCENTRIC ANISOTROPIC IONOSPHERE
James R. Wait *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 239–256 refs Repr. from Can. J. Phys., v. 41, Feb. 1964 (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

The theory of the propagation of electromagnetic waves in the space between a spherical conducting earth and a concentric ionospheric reflecting layer is treated. The problem is idealized to the extent that, at the boundaries of this spherical waveguide, the tangential field components are related in a prescribed way. In the case of the ground, the relation involves a scalar surface impedance whereas, for the ionosphere, it is necessary to employ a reflection coefficient or surface impedance in the form of a matrix. On this basis a solution is sought for the total field produced by a vertical electric dipole. Explicit results are obtained under the assumption of azimuthal symmetry. By applying the Watson transformation, a representation in terms of guided waves is obtained. This form of the solution was used previously to obtain specific results. Author

N64-19695 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
PHASE VARIATIONS IN V.L.F. PROPAGATION
Charles J. Chilton, Douglass D. Crombie, and A. Glenn Jean *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 257–290 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

The experimental work describing the variation in phase of VLF signals received after ionospheric reflections at small

and large distances is reviewed. At all distances, regular systematic variations in phase occur when the path changes from day to night. These variations are closely related to solar illumination. This diurnal change in phase can be interpreted as a variation in the effective height of reflection of the ionosphere. The magnitude of the diurnal phase change is large at small distances, apparently decreases to a minimum at distances of the order of 1,000 km, and thereafter increases as the length of path going from daylight to dark increases. R.T.K.

N64-19696 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
PROPAGATION OF V.L.F. RADIO WAVES IN THE IONOSPHERE
Daniel W. Swift *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 291–319 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Equations describing the propagation of radio waves in a horizontally stratified anisotropic ionosphere were developed by considering the limiting case of a large number of infinitesimally thin slabs of constant electron density and collision frequency. The quasi-longitudinal approximation was used. The propagation equations appeared as four coupled first-order linear differential equations, coupled by gradients in electron density and collision frequency. The quasi-longitudinal approximation permitted use of particularly simple forms for the coupling coefficients, these forms being amenable to simple analysis. Coupling between two ordinary or two extraordinary modes was found to be considerably stronger than cross-coupling between ordinary and extraordinary modes. Cross-coupling was related to the rate of change of the direction of the phase normal. Author

N64-19698 Army Signal Research and Development Lab., Fort Monmouth, N.J.
RECENT V.L.F. WORK AT THE U.S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY
F. H. Reder and G. M. R. Winkler *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 335–338 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

A review is presented of VLF and LF propagation studies and long-distance clock synchronization experiments that have been conducted at USAERDL since 1959. Atomic Cs beam frequency standard, type NC 1001, was used for driving transmitters and clocks, and for providing local references for VLF and LF receivers. Measured values of the depth of the phase trapezoid patterns for various VLF transmission paths are included. R.T.K.

N64-19776 Young (David W.) and Associates, Inc., Canoga Park, Calif.
HIGH SPEED, RASTER SCANNING, HIGH RESOLUTION, RADAR SENSOR FOR VERTICAL DISPLAY Interim Technical Report, 1 Sep. 1962-30 Jul. 1963
D. W. Young [1964] 82 p refs
(Contract Nonr-4032(00))
(AD-435558)

This report describes what work has been done, what is being created, and describes the radar sensor design concept, how the radar sensor outputs can be displayed, and how the radar system can be used. The system is a high-speed, raster scanning, high-resolution radar used with a vertical display. The result is similar to television with range measurement capability. There are two antennas, each mounted approximately perpendicular to one another. One antenna is located in the plane of lift (horizontal) and the other in the plane of the longitudinal axis of the volume required for the man (vertical) and incidentally associated with lateral aircraft stability (rudder, dihedral, etc.). A transparent windshield display is introduced to allow correlation or comparison of human optical sensing and microwave (radar) sensing. Author

N64-19820 Aerospace Corp., El Segundo, Calif. Engineering Div.
TRACKING, TELEMETRY, AND COMMAND STUDIES OF GROUND AND SATELLITE SUBSYSTEMS. VOLUME IV: AIRBORNE TRANSPONDER CONFIGURATION STUDY
D. Matson Dec. 1963 78 p refs
(Contract AF 04(695)-269)
(TDR-269(4110-01)-13; SSD-TDR-63-334, Vol. IV; AD-438032)

The report discusses the system requirements that reflect upon the design of CW satellite transponders. The Mariner prototype transponder and the Goddard range and range rate transponder are taken as currently operational examples of the state-of-the-art. These two transponders are described in detail. Their primary advantages and disadvantages are noted. Author

N64-19821 Aerospace Corp., El Segundo, Calif. Electronics Div.
ON THE LOGICAL ESTABLISHMENT OF GLOBAL SURVEILLANCE AND COMMUNICATION NETS
B. H. Billik and H. L. Roth 3 Mar. 1964 45 p refs
(Contract AF 04(695)-269)
(TDR-269(4513-10)-5; SSD-TDR-64-5; AD-437121)

This report establishes criteria for the formation of global surveillance and communication nets and synthesizes some practical examples of these nets. Four properties are postulated that supply all of the necessary and sufficient conditions for the formation of nets. Certain lower bounds are obtained for the numbers of satellites and/or ground stations necessary for establishing worldwide surveillance and communication capability. It is shown that nets can be obtained that are competitive with orbital systems providing only surveillance of the globe. Tradeoffs between the number of ground stations and the number and altitude of satellites in a net are discussed at length. Author

N64-19863 Tactical Air Command, Langley AFB, Va.
OPERATIONAL TEST AND EVALUATION OF SELECTED COMMUNICATIONS AND GROUND POWER EQUIPMENT UNDER COLD WEATHER CONDITIONS
Edward P. Gumphrey, Joseph C. Alonge, and Robert T. Starke Jan. 1964 15 p
(TAC-TR-63-73; AD-428758)

This test was conducted to determine the capabilities of selected communications and ground power equipment to operate under cold weather conditions, prior to winter use of the same equipment on a field exercise in Alaska. It was concluded that the AN/TSC-15 and AN/MRC-94 Communications Centrals, the AN/PRC-25, AN/PRC-41, and AN/PRC-47 Radios, as well as the PU-549/G Generator Set, can be operated at a temperature of −40° F, when certain precautions and procedures are observed. Author

N64-19876 Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Lab.
A GRAPHIC TECHNIQUE FOR RADOME RAY ANALYSIS
Paul J. Carroll 27 Jan. 1964 33 p refs
(NADC-EL-6368; AD-429185)

A method is presented for applying ray tracings to a standard set of radome prints to determine component values of the

angles of incidence of radar antenna radiation impinging on a radome wall. Equations were developed that determine the true angles of incidence and polarization as a function of these component angles; a sample ray study is illustrated; and a tapered, half-wave, solid-wall design is presented. Author

N64-19915 Boeing Co., Seattle, Wash.
MINUTEMAN HF RADIO COMMUNICATIONS SYSTEM TEST REPORT
P. N. Hales Jan. 1964 41 p refs
(Contract AF 04(647)-289)
(T2-3188-1)

The purpose of the tests was to discover the cause of, and to find and verify solutions to, those problems identified by the Functional Compatibility Test, and to identify and solve any other system problems encountered. The identified and investigated system problems were: directional coupler diode failure, false tune of antenna, and excessive system SWR after fine tune. Solutions to these system problems were found. Author

N64-19942* California U., Berkeley Space Sciences Lab.
THE PROPAGATION OF ELECTROMAGNETIC WAVES IN A STATISTICALLY INHOMOGENEOUS MEDIUM. I: A CRITIQUE OF THE CURRENT THEORY
Samuel Silver 27 Apr. 1964 37 p refs
(NASA Grant NsG-243(62); Contract Nonr-222(54))
(NASA CR-53926; *Its* Ser. 5, Issue 29) OTS: $3.60 ph

The theory of propagation of electromagnetic waves in a statistically inhomogeneous medium is examined for (1) the discrete scatterer model, and (2) the perturbed continuum model. The theory is based on the assumption that the lifetime of a configuration of the system is long compared with the period of the primary time harmonic wave. It is generally assumed also that averages of the field obtained by the ensemble method are equivalent to long time averages over the time series that the actual field constitutes. These assumptions are examined, and their implications are pointed out. It is shown that there is a complete correspondence between the methodology used for the discrete scatterer model and the perturbed continuum model. Author

N64-19949 Illinois U., Urbana Antenna Lab.
A 500:1 SCALE MODEL OF WARLA – A WIDE APERTURE RADIO LOCATION ARRAY Technical Report No. 2
J. W. Greiser and G. S. Brown Sep. 1963 45 p refs
(Contract NObsr-85243)
(AD-429235)

This report describes the design, construction, and testing of a microwave scale model of a circular array of broadband antennas. The ultimate goal of this work is the construction of a high-gain direction-finding array using frequency independent antennas that would permit efficient operation over the 2 to 32 mc range. The scale model is an attempt to experimentally verify certain theoretical results that were obtained from calculations performed on a computer. Restrictions imposed on the array by the necessity of keeping interelement phase center spacings less than approximately 0.75 wavelengths have forced the use of three sets of log-periodic elements, one set being added for each higher frequency band. Typical radiation patterns of the model are presented, and their relation to computed patterns is discussed. Author

N64-19958* Ohio State U. Research Foundation, Columbus Antenna Lab.
RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS Semi-Annual Report, 1 Sep. 1963-29 Feb. 1964
1 Mar. 1964 17 p refs
(NASA Grant NsG-74-60)
(NASA CR-53871; Rept. 1093-19) OTS: $1.60 ph

The purpose of this research program is to investigate various detection, generation, and receiver techniques, both conventional and nonconventional, in the millimeter and submillimeter wavelength regions. Most of the effort has been directed toward the development of a submillimeter radiometer. Additional work conducted includes an investigation of a carbon bolometer as a detector, and an attempt to cool rare earth crystal samples to liquid helium temperatures in order to study the absorption spectra of rare earth ions. R.T.K.

N64-19990* General Electric Co., Philadelphia, Pa. Valley Forge Space Technology Center
OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY, VOLUME I: SUMMARY, CONCLUSIONS, RECOMMENDATIONS Final Report
S. R. Hurst et al Mar. 1964 36 p refs
(NASA Contract NASw-540)
(NASA CR-53636) OTS: $3.60 ph

The ultimate potential of optical space communication and the problems of realization are discussed. Overall conclusions and recommendations are presented. Performance of a preliminary analysis of three assigned missions, with the object of identifying the salient advantages and problem areas of optical communication was summarized. A wide variety of environmental and equipment factors are also summarized. To assess the ultimate potential of an optical communication system, the theoretical information capacity of a noisy quantized wave was derived. The theoretical performances of the major types of receivers (heterodyne, homodyne, and quantum counter) were analyzed and interpreted. Propagation in the atmosphere and special considerations in low-level photodetection are treated. Selection of heterodyne detection is justified, and component requirements in a heterodyne communication system are analyzed. This system was applied to the following missions of interest, and the performances are calculated: Mars–Earth terminal, Mars–Earth satellite, Moon base–Earth terminal. The results of the performance calculations are presented. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-19388 Stanford Research Inst., Menlo Park, Calif.
THERMOELECTRIC MATERIALS Quarterly Progress Report No. 2, 8 Jul.-8 Oct. 1963
J. W. Johnson 14 p
(Contract NObs-88487)
(AD-430159)

The resistivities and Seebeck coefficients of the bismuth sulfide-cuprous sulfide system in the liquid state were measured for melts containing 25, 50, and 75 mole percent bismuth sulfide. The Seebeck coefficient data support the view that addition of a p-type liquid to an n-type liquid produces changes

directly proportional to the amount of p-type material added. The resistivity data are not so simply explained, and some speculations concerning the conduction process are proposed. Author

N64-19389 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
STUDY OF A THERMOPHOTOVOLTAIC CONVERTER Second Quarterly Progress Report, 1 May-31 Aug. 1963
Nov. 1963 43 p refs
(Contract DA-36-039-AMC-02255(E))
(P63-242; AD-424672) OTS: $4.60

Materials and components for a thermophotovoltaic converter were studied theoretically and experimentally. Germanium photovoltaic cells were tested at output power-densities ranging up to 1.9 watts/cm^2 under high illumination levels; grid design calculations were carried out on the basis of these measurements. Techniques were developed for mounting high power-density, optically-aligned photocells on a cylindrical cooling jacket. Two semi-conductor materials were examined as possible alternatives to germanium. Preliminary data are included on the reflectivity of emission enhancement coatings on a ceramic substrate; experiments were performed to determine the life of a new diffusion coating on a metallic substrate. The design of a special reflection measuring fixture was completed and its assembly started. This design was required because of shortcomings in commercial spectrophotometers for this application. An analysis of the convective-loss problem is included and shows that this loss should be less than 10% of the net radiated energy. Author

N64-19396 Illinois U., Urbana Coordinated Science Lab.
SYNTHESIS OF SOME DISTRIBUTED RC NETWORKS
Cassius A. Hesselberth Aug. 1963 82 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-164; AD-418171)

The following are discussed: (1) distributed networks with rational transfer functions—motivation and status, the structure and its transfer impedance, the driving-point impedances, an alternate connection for realizing rational transfer impedances, open-circuit voltage transfer functions, a rational transfer admittance, physical realizability of the resistance functions, and synthesis; (2) distributed RC resistance capacitance filters—low-pass filters with sharp cutoff, high-pass filters, distributed RC notch filters, increasing the total useful capacitance in the notch filter, lossy dielectrics in distributed RC notch filters; (3) constant-phase deriving-point admittances—the ideal case, the network of finite length, examples, and other physical considerations. R.T.K.

N64-19402 Illinois U., Urbana Coordinated Science Lab.
BASHKOW'S A MATRIX FOR ACTIVE R,L,C, NETWORKS
Ahmet Dervisoglu Jul. 1963 12 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-175; AD-420507)

A way of writing the $\underline{A}$ matrix of Bashkow by inspection of an active R,L,C network is given. It has been assumed that the network has a tree that contains all capacitances and voltage sources as branches and all current sources and inductances as chords. In this case, two matrix equations may be written by inspection; in solving these equations, the $\underline{A}$ matrix, currents, and voltages of passive elements may be calculated. One of these matrix equations represents the resistive part of the network, and if the network does not contain resistive elements, then there is only one matrix equation and the $\underline{A}$ matrix may be written directly. Author

N64-19492 Joint Publications Research Service, Washington, D.C.
A NEW METHOD OF TEMPERATURE COMPENSATION FOR SUPERHIGH FREQUENCY THERMISTORS FOR POWER MEASUREMENTS
L. M. Zaks and V. M. Petrov 5 May 1964 12 p refs Transl. into ENGLISH from Tr. Kom. Standartov Mer i Izmeritel'nykh Priborov (Moscow), v. 45, no. 125, 1962 p 13-20
(JPRS-24477; OTS-64-31206) OTS: $0.50

A new method is described for thermocompensation of thermistor power-measuring devices by using inertial thermistor in the feedback circuit of the stabilizer feeding the measuring bridge. The method makes accurate adjustment possible by changing the readings of the power-measuring device. The circuit design is given, and the results of an experimental check are given showing that readings with an instability of 0.05 μv/min maximum may be attained. Author

N64-19502 Sigma Instruments, Inc., Braintree, Mass.
SOME CONSIDERATIONS OF POWER SWITCHING WITH SEALED RELAYS IN SPACECRAFT SYSTEMS
Sohier D. Marks and Daniel R. Saewert (Motorola, Inc.) *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 11 p refs (See N64-19501 12-01)

Results obtained in the evaluation of subminiature sealed relays for applications in manned spacecraft systems are discussed. Three of the results and their implications are considered in detail: heat transfer, metal vaporization, and long path arc discharges. It is concluded that arc characteristics in a vacuum have a far more severe effect on relay performance than at one atmosphere. Reliable performance can be assured by never letting the contacts operate in a vacuum and by inhibiting the arc. In the event of seal failure, proper arc suppression would eliminate a major portion of the heat in the switch, and would minimize metal vaporization and the probability of long path arc discharges. P.V.E.

N64-19503 ITT Kellogg, Chicago, Ill. Telecommunications Div.
ECONOMICAL MAGNETIC MEMORY DEVICE
Weichien Chow and Alfred R. Lucas *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 23 p (See N64-19501 12-01)

This paper describes a new magnetic drum memory that has been developed as a low-cost storage device that does not require ancillary amplification for either input or output functions for switching and control systems. This memory device has some features that are characteristic of a digital computer memory, but it does not have the latter's high cost. The new memory device can be used either as a general purpose bit store, or as the main storage device in switching-control systems. The design of the memory and its typical applications are presented in this paper. Author

N64-19504 Consolidated Electronics Industries Corp., Frederick, Md.
HAZARDS IN THE USE OF DOUBLE-THROW CONTACTS
P. N. Martin *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 20 p refs (See N64-19501 12-01)

In the application of relays with double-throw contacts, consideration should be given to the possibility of trouble that might be caused by an arc drawn between the N.O. and N.C. contact during transfer. This possibility for trouble does not seem to be present if only the moving contact of the set is

connected to the power source except for the situation in which a pair of double-throw contacts are interwired to provide a pole-changing arrangement. The recognized method for providing assured safety in such applications as transferring a load from one power source to another is, instead of using a double-throw contact, to use two relays with normally open contacts and to have the coils of the relays electrically interlocked. In this arrangement the control circuit for each coil is carried through an N.C. auxiliary contact on the other relay so that the coil of either relay cannot be energized until the other relay has closed its deenergized contacts. Author

N64-19507 Cook Electric Co., Chicago, Ill.
THE CAUSES AND EFFECTS OF FRETTING EROSION ON CONTACT SURFACES
Harry L. Wickstrom *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 8 p (See N64-19501 12-01)

A study of contact contamination from fretting erosion experienced in a.c. coil relays is summarized. In the majority of cases, the effects of fretting within d.c. coil relays are negligible, although rubbing or sliding motion is present during the making and breaking of contacts. The manufacturer and the relay circuit designer should be aware of its effects, since the phenomena is always present to some degree. In selecting contact material, the degree of fretting should be known in an a.c. coil relay where some force ripple is present. Its influence in total relay life can be a large factor. P.V.E.

N64-19509 G-V Controls, Inc., Livingston, N.J.
TRANSISTORIZED RC TIME DELAY RELAYS
W. Pecota *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 21 p (See N64-19501 12-01)

The basic principles of operation of the RC type time-delay relay are presented. This type of device is generally identified by a capacitive network in which the time required for a capacitor to charge or discharge is used to control the conductive state of one or more subsequent networks. The discussion is further restricted to devices with control intervals in the time range of 10 msec to 15 min. Basic circuits are analyzed, and the limitations imposed upon these circuits by available components are investigated. System requirements are discussed and compared to the performance of integrated networks. Special function networks are shown, and their purposes are discussed. Performance characteristics most often encountered and problems frequently faced are also analyzed. Author

N64-19513 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RELAY RELIABILITY STEMMING FROM SPECIFICATIONS AND APPLICATIONS
E. U. Thomas *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 16 p refs (See N64-19501 12-01)

Developing specifications for relay reliability are discussed. The sources for many of the misapplications of relays are indicated. For multipole relays, data sheets should list the loads for which the relays are applicable, and those for which they are not suitable. If a.c. loads are applicable, the frequencies should be listed in separate columns, and if the relay is for single-phase loads only, this should be so stated, so that the relay cannot be applied erroneously to three-phase circuits by the uninitiated. Pickup and dropout voltages, when listed, should be specific as to whether they apply to room temperature only, or whether they cover the entire temperature range for which the relay was designed. P.V.E.

N64-19514 Struthers-Dunn, Inc., Pitman, N.J.
RELAYABILITY APPLIED TO RELIABILITY
John S. Jordan *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 10 p (See N64-19501 12-01)

Some ground rules are discussed for determining and improving the reliability of relays through realistic specification and application review, before manufacturing a high-reliability part. If the reliability of relays is a factor, the requirements of the application must be specifically stated. Test conditions must be identical for similar relays of different manufacture to be compared. P.V.E.

N64-19515 Leach Corp., Los Angeles, Calif. Leach Relay Div.
INCREASED RELAY RELIABILITY THROUGH PROPER APPLICATION
Charles B. Rau and Ben Winters *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 22 p refs (See N64-19501 12-01)

A recommended approach is presented for the drafting of specification requirements, and the proper selection of relays by the design engineer, components engineer, specifications engineer, reliability engineer, and buyer. P.V.E.

N64-19516 Bureau of Ships, Washington, D.C.
BUREAU OF SHIPS PROGRAM TO DETERMINE THE CHARACTERISTIC LIFE PROFILES OF ELECTROMAGNETIC AND THERMAL TIME DELAY RELAYS
Joseph Brooks and Daniel N. Schochet (Associated Testing Labs., Inc.) *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 22 p refs (See N64-19501 12-01)

A test plan is discussed for evaluating the reliability of hermetically sealed relays, based on data and information gathered from literature of relay manufacturing and testing, and from discussions with manufacturers. Experiments performed under the plan will determine the effects of different levels of continuous operation and of simulated environmental conditions on the life characteristics of the relays. The generic failure rates in terms of percent failures per 10,000 operations will be established. This is to be accomplished by testing a total of 3,280 relays for 1 million operating cycles each. Whereas failure rate criteria are based upon an assumed exponential failure distribution, these experiments will assume the underlying failure distribution to be Weibull in nature. P.V.E.

N64-19518 Army Signal Research and Development Lab., Fort Monmouth, N.J.
EFFECTS OF COMBINED OPERATING ENVIRONMENTS ON RELIABLE RELAY LIFE
A. P. Boylan, W. J. Fontana, and W. H. Lesser (GE) *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 26 p refs (See N64-19501 12-01)

Results of this test program successfully showed the effects of combined operating environments on relay life. In general, an increase in contact current, contact voltage, or ambient temperature will reduce expected life, but an increase in coil voltage and rate of contact operation will increase expected life. Some reversals, however, were found in certain environmental combinations. The use of equations to predict expected relay life appears to be valid over most of the operating range covered by sample tests. Author

N64-19519 International Business Machines Corp., Burlington, Vt. General Products Div.
PRACTICAL CONTRIBUTIONS IN TESTING RELAYS
Francis J. Soychak *In* Okla. State. U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 14 p (See N64-19501 12-01)

In testing relays, the primary consideration is to decide what detection level and time duration define a contact miss. A voltage detection level of .1 times the load supply voltage was selected and is justified when the power supply is ±10%. Time duration for a miss of ≥80 μs was selected to allow for variations in test equipment, and to provide data applicable to solid-state circuits having delays of 1 to 5 μs. Provisions were designed into the test equipment to permit it to lock in the state of miss, or to record the number and time of occurrence of each miss. When error was caused by counter noise generated into the system, the situation was corrected by suppressing the coil for the electromechanical counter. A voltage-sensitive amplifier was used, and resistor–capacitor suppression networks were placed directly across the contacts rather than the load. The coil-drive frequency was set at 166 2/3 cps, 50% duty cycle during a test of reed relays. A.W.

N64-19520 Western Electric Co., Inc., Allentown, Pa.
MERCURY RELAY ADJUSTMENT TECHNIQUES
H. D. Marshall *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 34 p refs (See N64-19501 12-01)

Adjusting monitoring techniques for testing mercury-wetted contact relays include: (1) bias adjustment; or (2) polar adjustment. The magnetize–demagnetize adjusting circuit is explained for the 276 code and the 291–303 codes. The sensitivity adjustment sequence is set up as follows: both magnets are fully saturated; adjusting circuit is set to demagnetize the bias magnets one at a time; the magnet attached to the operate contact is partially demagnetized, and the release magnet is demagnetized. A slight modification allows polar adjustment with the same basic circuit. The report concludes with a discussion of rectifiers, phase detectors, high sensitivity, and overload protection. A.W.

N64-19521 Bell Telephone Labs., Inc., Columbus, Ohio
EVALUATION OF RELAY LIFE
C. B. Brown *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 15 p refs (See N64-19501 12-01)

This report deals with test methods for assessing the life of a general purpose telephone relay in terms of its expected rate of readjustment. Variables data are taken for the following characteristics: operate current; release current; operate time; release time; armature travel; back tension; and contact gaging. Periodic measurements of these characteristics provide an indication of their degradation rate. The proposed data analysis technique is that of a curve showing the relationship between the number of operations and the probability of need for readjustment. The relays used had gaging requirements for their break contacts of maximum 0.017 in. and minimum 0.006 in. A.W.

N64-19523 Philco Corp., Palo Alto, Calif.
NON-DESTRUCTIVE TESTING FOR PARASITIC ARC SUSCEPTIBILITY IN RELAYS
Thomas N. Lockyer, Jr. *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 19 p refs (See N64-19501 12-01)

It is demonstrated that susceptibility to parasitic arcing can be determined by a d.c. test circuit where the life of the main arc is electronically adjusted in conjunction with an auxiliary circuit supplying a current-limited d.c. voltage between the main arc and the case. The parasitic breakdown voltage is exponentially related to the current-time integral of the main arc. The negative exponential curve becomes asymptotic at $t = 0.4$ msec and $t = \infty$ for crystal case relays at 700 v and 50 v (or greater), respectively. The susceptibility ranges from 8 to 0 for crystal case relays, as defined by empirically derived formulations. Susceptibilities determined by the d.c. test may be extended to a.c. conditions by relating the current–time integrals of the main arcs. Author

N64-19524 Thermosen, Inc., Stamford, Conn.
DEVELOPMENT OF THE MULTIREED RELAY – A SMALL COMPANY'S APPROACH TO RELAY DESIGN
Nathan H. Magida *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 22 p (See N64-19501 12-01)

This report describes the development of a new type of electromagnetic relay known as the multireed relay. The basic structural materials used were thermosetting materials such as diallyl phthalate or a molding-type epoxy. Silver-based alloys were selected for contact materials. So far as cleaning techniques are concerned, the multireed relay has the advantage that the coil is not an integral part of the relay assembly and is not attached to the basic structure until after all cleaning processes are complete and the enclosure has been sealed. A.W.

N64-19525 Phillips Control Co., Joliet, Ill.
A MERCURY-NEEDLE RELAY
Harold P. Schultz *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 12 p refs (See N64-19501 12-01)

The question of reliability in the design of miniature relays was approached through the basic construction of a mercury-needle relay. Basically it is an adaptation of the plunger relay, except that the contacts have been brought into direct contact with the armature, which is not only an actuator but a contact itself. It is called a needle relay because the armature is of magnetic material with a high L/D ratio. The selection of this permanent magnet material is the most important area in the design of the needle relay. Preliminary test data show no indication of contact failure due to erosion nor have environmental tests shown any failure of mercury in terms of maintaining its required position. A.W.

N64-19526 Phillips Control Co., Joliet, Ill.
A NEW CONCEPT IN SOLID STATE RELAYS
Wesley Koeffler *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 16 p refs (See N64-19501 12-01)

This report concerns the use of the silicon-controlled rectifier (SCR) as the basic switching mechanism for electrical currents. The inherent limitations of the semiconductor are discussed—high contact resistance, low insulation resistance, and vulnerability to high ambient temperature (100° C). Circuits to nullify the forward drop of the SCR to reduce the holding current were tested. The report concluded that the SCR concept best lends itself for switching application with a minimum of associated electronic circuitry. A.W.

N64-19527 North American Aviation, Inc., Columbus, Ohio
THE DESIGN ENGINEER'S MOST RELIABLE PIECE OF HARDWARE, THE GENERAL PURPOSE RELAY – PHASE II

C. W. Derrickson and C. P. Wegenka *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 15 p (See N64-19501 12-01)

This report demonstrates the reliability achieved to date for relays used on A-5A aircraft through the presentation and analysis of failure data. By comparison of general purpose relays with special purpose relays, it is concluded that the latter are not nearly as reliable as the former. Static switching, however, is not as reliable as electromagnetic switching for general purpose use when the duty cycle does not exceed 10 actuations per hour and coil voltage is applied most of the time. A.W.

N64-19529 Compagnie Générale de Télégraphie sans Fil, Paris (France)
STUDY ABOUT IMPACTS AND DAMPING PROBLEMS IN A FAST MINIATURE TELEGRAPH RELAY
J. Pandelle and M. Tacnet *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 16 p refs (See N64-19501 12-01)

In order to make a fast miniature relay, the moving armature must be lightened and damping must be introduced in the flexible contact support movement to avoid the appearance of another rebound phenomenon resulting from the oscillating movement of contacts. After experimentation, friction damping was chosen as the means of damping over the electromagnetic kinds, because electromagnetic damping, being a function of armature movement, tends to reduce the speed of this movement. A.W.

N64-19530 Oklahoma State U., Stillwater School of Electrical Engineering
RELATIONSHIP BETWEEN DESIGN AND SPECIFICATION
D. D. Lingelbach *In its* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 14 p refs (See N64-19501 12-01)

This paper discusses design as involving the selection of a set of parameters, and specification as the restriction on the set of parameters. It emphasizes the fact that a given set of requirements placed on a system or device may be conflicting. To prove this, a mathematical model was used because one of its properties is that the number of parameters is at least equal to or greater than the number of relationships. A row and a column arrangement of symbols were set up; the row entries being the different parameters and the column entries being these parameters in a given relationship. The experiment proved that only a given number of parameters can be assigned arbitrary numerical values. The number of these parameters was equal to the total number of different parameters minus the number of different relationships. Any combination of parameters containing all the parameters in any one relationship used to construct the model cannot have arbitrary assigned values. A.W.

N64-19531 Nippon Electric Co., Ltd., Tokyo (Japan)
DYNAMIC ANALYSIS OF THE RELAY AND ITS APPLICATION TO THE IMPROVEMENT OF THE PULSE RELAY
Hideo Kubokoya *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 32 p refs (See N64-19501 12-01)

The operate and release characteristics of motion of the general purpose relay were analyzed by solving the equation of motion by Lagrange-Maxwell. The characteristics of motion that were obtained conform very well to practical conditions. One demerit of the impulse relay has been that it causes impulse distortion, due to the trunk line resistance, circuit conditions, and characteristics of the relay, and instability of the impulse characteristics by chattering. This analysis shows that the most effective way to prevent these demerits is to increase the magnetic pull and reduce the time constant. In this way impulse distortion can be practically eliminated. It is further found that even if the trunk line resistance increases more than ten times, superior impulse characteristics can be maintained. Author

N64-19532 Minneapolis-Honeywell Regulator Co., Freeport, Ill. Micro Switch Div.
PERMANENT MAGNET BIASING AND OPERATION OF DRY REED SWITCHES
Fred C. Ebert *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 16 p (See N64-19501 12-01)

The principle area discussed deals with the operation and biasing of the DRS with the permanent magnet. The information on which this presentation is based was obtained from both theoretical and empirical data. Many different measurements and fixturing arrangements were used. These included Hall probes, search coils, and magnetoresistive elements for magnetic measurements and an Instron tensile tester for force and deflection measurements. Both the miniature and standard DRS sizes are considered, as well as the symmetrical and asymmetrical designs. In addition to showing the general permanent magnet DRS operating characteristics, a nomenclature for referencing the permanent magnet to the dry reed switch is introduced. The mnemonic given this relationship is FEPSLAR. Author

N64-19534 North Electric Co., Galion, Ohio
ADJUSTABLE GLASS ENCAPSULATED REED RELAYS
Benjamin Mishelevich and Edward G. Tutle *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 24p refs (See N64-19501 12-01)

This paper reports on a new and unique electromechanical switching device. It is a reed relay that can provide a mechanical adjustment of certain operating characteristics. The range of adjustment is from 30% to 100% or more of just operate and operate time values. The particular range is dependent on the reed design and the specification of the input power used to drive the device. The means for adjustment does not cause the relay to be sensitive to polarity. Author

N64-19535 General Railway Signal Co., Rochester, N.Y.
DESIGN OF A NON-ADJUSTED RELAY
Wheeler D. Maynard *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 31 p (See N64-19501 12-01)

The type J nonadjustable relay is specifically designed to be used to control additional relays of the same type rather than for dry circuit applications or control of other equipment. Its fine silver contacts are suitable for circuitry in the 12- to 30-v range and are bifurcated to provide reliability for the electrical and mechanical life of the relay, which is in excess of 275 million operations. Operating power is approximately 3 w. Low-rate coil springs provide uniform and constant contact pressure. The type J relay uses a magnetic structure containing only two iron members and neither teners nor nonoperating joints; this reduces magnetic circuit variables and insures a matching pull curve. Relay operation with respect to iron flux density is also considered, as is the effect of the working air gap area on the relay pull. A.W.

N64-19536 Autonetics, Downey, Calif.
TODAY'S CHALLENGE TO THE RELAY INDUSTRY
W. M. Crawford *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 10 p (See N64-19501 12-01)

This paper discusses problems affecting relays, such as contamination, contact rating, contact resistance, and reliability. A.W.

N64-19538 Hathaway Instruments, Inc., Denver, Colo.
APPLICATIONS AND CHARACTERISTICS OF DRY REED RELAYS
Dale O. Ballinger *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 16 p (See N64-19501 12-01)

As an addition to the list of switching devices, the dry reed relay is discussed, specifically the dry reed with nominal dimensions of 1/8-in. diameter and 7/8-in. length. The reed is essentially a conductor roughly centered in a nonmagnetic, nonconducting cylinder. By surrounding this cylinder with a radiofrequency ground plane, the switch resembles a standard RF cable with a characteristic impedance of approximately 70 ohms and can be used as a section of a transmission line capable of being externally open or closed. The reed makes possible RF switching matrices of very high efficiency. The effective resistance of the reed arm itself is important, the effective depth of penetration of the RF current due to skin effect being approximately 2,000 μin. at 2 mc and 600 μin. at 25 mc. The dry reed becomes a contact capable of operating at 500 cps on a 50% duty cycle. A.W.

N64-19541 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RELAY DEFINITIONS AND TERMINOLOGY
E. U. Thomas *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 15 p refs (See N64-19501 12-01)

Proposed definitions of relay terms are listed as: polarized relay; polarized double-biased relay; polarized no-bias relay; relay, magnetic latch; and stick relay. A brief discussion of system rather than component terminology is given. The suggestion is made that standard definitions and terminology be adopted by industry. A.W.

N64-19542 ITT Kellogg, Chicago, Ill. Telecommunications Div.
APPROXIMATE POWER-TEMPERATURE RELATIONSHIPS FOR COPPER WIRE COILS
B. Giese *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 12 p refs (See N64-19501 12-01)

This report presents the general theory and considerations relating to power-temperature relationships for copper wire coils, and then proceeds to derive the specific formulas required for the analysis and design of such coils. A procedure for using these formulas with experimental data is given. A general discussion and the limitations of the application of these formulas are provided. Finally a list of nomenclature is provided for easy reference. Author

N64-19555 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
THE MAXIMALLY-FLAT DELAY FUNCTION OF LARGE ORDER
Sid Deutsch 27 Jan. 1964 30 p refs
(Contract AF 19(628)-3815; NSF Grant GP-2394)
(PIBMRI-1204-64; AD-433253)

The maximally flat time delay (or linear phase) transfer function is examined when the number of poles approaches infinity. The pole diagram is found to be closely approximated by an elliptical array of equivertically spaced poles. The amplitude, time-delay, and transient responses are derived. The elements comprising the output and input ends of a lossless low-pass ladder realization are also derived. Data are given to find the properties that are associated with any number of poles, large or small, by a graphical interpolation between the known extremes. Author

N64-19558 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
EXPERIMENTAL RESULTS CONCERNING THE CONICAL SCANNING ERROR SIGNAL OF A BROAD-BAND ANTENNA SYSTEM Technical Memorandum
Harold F. Rearick 5 Dec. 1963 44 p
(Contract DA 36-039-SC-87499)
(EDL-M442; AD-433489)

A description of the error signal created by conical scanning was experimentally obtained for a passive tracking antenna system designed to operate from 1.5 Gc to 12 Gc. The information obtained consisted of the error signal fundamental-null position, the error signal fundamental-gradient, the amplitudes of the harmonic components of the error signal and the phase of the error-signal fundamental as functions of target-error angle, target-position angle, received frequency, and polarization. Author

N64-19560 RAND Corp., Santa Monica, Calif.
PLANE PHASED ARRAYS: DEPENDENCE OF GAIN ON STEERING, THINNING AND ELEMENT DIRECTIVITY
Worthie Doyle Mar. 1964 45 p refs
(ARPA Order 189-61; ARPA-SD-79)
(RM-3963-ARPA; AD-437763)

Two related topics in the design of plane phased arrays are discussed. One is the dependence of gain upon thinning, steering, and element directivity; the other is a systematic procedure for locating the elements of highly thinned, plane arrays. A few general observations on the effects of thinning and steering can be made from the expression for the gain of an array of elements having an arbitrary directivity factor. The specializations to isotropic elements and to infinitesimal dipoles are then made, and these observations are verified for some actual arrays. Author

N64-19563 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HIGH TEMPERATURE ANTENNA INVESTIGATION AND DEVELOPMENT Quarterly Interim Engineering Report No. 3
Godfrey F. Buranich [1963] 21 p ref
(Contract AF 33(657)-11100)
(CAL-UB-1807-E-3; AD-426802)

This report summarizes engineering effort investigating the design of antennas that are suitable for prolonged operation at a temperature of 2,000° F or higher. A 2-in.-thick foamed concrete radome has been made, and silicon carbide heating elements were inserted through it. An input of about 3 kw to the heating elements was sufficient to heat a stainless steel S-band waveguide with an alumina window mounted in a ground plane to a temperature of 2,000° F. VSWR measurements were made on this (unmatched) assembly over a temperature of 70° to 2,000° F. The VSWR of 6.0 at room temperature increased to 6.8 at 2,000° F. Author

N64-19576 California Computer Products, Inc., Downey
CAPABILITIES OF CALIFORNIA COMPUTER PRODUCT (CALCOMP) FOR LUNAR ORBITER
[1963] 45 p refs
(TR-63-307)

The methods, equipment, and specific component specification used in the fabrication and component burn-in capabilities of high-reliability circuit boards are discussed. A chart is included that shows the sequence of operations used in qualifying components. R.T.K.

N64-19591* Radio Corp. of America, Somerville, N.J. Semiconductor and Materials Div.
DESIGN, DEVELOPMENT AND FABRICATION OF FAST SILICON POWER TRANSISTORS Summary Report, 28 May 1962-28 Aug. 1963
D. R. Carley and R. Rosenzweig 1963 119 p refs
(NASA Contract NAS8-5006)
(NASA CR-53841) OTS: $9.60 ph

The development of a 20-ampere silicon switching-transistor is summarized. Described is the theory resulting from the final design of the device. Also described are the device fabrication procedures, including research leading to final processing techniques. Presented are the testing methods used and an evaluation of the 45 prototype samples delivered to the contracting agency. Author

N64-19600* Correlated Data Systems Corp., Glendale, Calif.
VELOCITY SERVO VOLTAGE CONTROLLED OSCILLATOR Final Report
Arnold C. Knudsen 31 Aug. 1962 12 p
(NASA Contract NAS7-100)
(NASA CR-53737; CDS-J-17) OTS: $1.60 ph

A general description of the operation of the velocity-servo voltage controlled oscillator is presented along with descriptions of the mechanical and electrical layouts. The following circuit components are discussed in some detail: chopper amplifier, summing node, oscillator, voltage sensor and variable gain filter, waveshaping circuit, nonbinary gate, resolver drive amplifier, flip-flops, resolver output waveshaper, and power supply. P.V.E.

N64-19659 Sperry Gyroscope Co., Great Neck, N.Y. Electronic Tube Div.
TRAVELING-WAVE-TUBE MIXER Technical Documentary Report, 1 Apr. 1961-31 May 1963
L. Magill Wright-Patterson AFB, Ohio. Res. and Tech. Div., Mar. 1964 37 p refs
(Contract AF 33(616)-8074)
(NA-8220-8366; RTD-TDR-63-4217; AD-437812)

The results of a research and development program are described for a two-helix traveling-wave-tube mixer capable of operation from 50 to 60 Gc. An experimental X-band mixer was constructed in a glass shell, but never tested because of difficulties in achieving satisfactory coupling. A full-frequency traveling-wave-tube mixer—having low ka, high frequency, low voltage, and wide bandwidth—was designed. Difficulty arose from using molybdenum in the tube shell and support structure. Molybdenum solved the problem of thermal-expansion differences between the tube shell and ceramic supports, but made brazing, plating, and machining difficult. All brazing efforts failed, so a device was constructed and sealed by an epoxy adhesive. Author

N64-19753 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STATISTICAL EVALUATION OF THE BEAM DISPLACEMENT IN A SYSTEM OF RADIATORS
O. G. Vendik 20 Jan. 1964 16 p refs Transl. into ENGLISH from Radiotekh. i Elektron. (Moscow), v. 8, no. 7, 1963
(FTD-TT-63-1079/1+2; AD-433531)

The relative rms dispersal, characterizing the angular accuracy of beam position, is calculated for an antenna in the form of a system of radiators (emitters). The calculation depends on the rms dispersals of current amplitudes and phases in individual emitters. The results are true for systems having maximum directivity coefficient of action in a given direction and a sufficiently low mutual relationship between the emitters. Author

N64-19770 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERNAL OSCILLATIONS IN p-n-p-m TRANSISTORS
N. A. Shekhotsov, E. D. Prokhorov, and B. V. Safronov 19 Feb. 1964 9 p refs Transl. into ENGLISH from Radiotekh. i Elektron. (Moscow), v. 8, no. 10, 1963 p 1783–1786
(FTD-TT-64-68/1+2; AD-433541)

The complex dependence of the coefficient of amplification in accordance with the current alpha of type p-n-p-m transistors is explained by the occurrence of internal oscillations. The investigation of these oscillations was made in the system for measuring alpha on d.c. with resistances in the collector circuit, that is, those that satisfy the short-circuit mode of operation. A.W.

N64-19803 Sperry Microwave Electronics Co., Clearwater, Fla.
DEVELOPMENT OF C-BAND BEACON FERRITE DUPLEXER, PHASE III Final Report No. 4, Feb. 1962-Oct. 1963
J. Brown [1963] 81 p refs
(Contract DA-36-039-SC-89158)
(SJ.M-220-0037-4; AD-429315)

Two principal designs were evaluated: (1) a four-port junction circulator used in conjunction with a high-power coaxial load and broadband fixed-tuned gyromagnetic coupling limiter; and (2) the same circulator and load but with a low-threshold subsidiary resonance limiter followed by a varactor limiter. In the course of the program the latter configuration was chosen as the most promising approach. Both approaches are discussed to the extent to which they were investigated. Final results of the program are presented. It is shown by final data that the original design goals were essentially met. Author

N64-19806 SFD Labs., Inc., Union, N.J.
DEVELOPMENT OF A Ku-BAND CROSSED-FIELD AMPLIFIER
John Mc Bride and Fred Feulner Oct. 1963 27 p refs
(Contract NObsr-89517)
(SFD-32-IDR-1; AD-428495)

Crossed-field amplifier experience is reviewed, and it is shown that the amplifier circuit best suited for this program is a choke supported interdigital line. This circuit has been proved electronically sound at X-band, and the K_μ-band dispersion curve indicates that it can readily be scaled to higher frequencies. Impedance matching transformer studies, using brass cold test models, exhibit a very low VSWR. Author

N64-19807 SFD Labs., Inc., Union, N.J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Second Interim Development Report, 30 Sep. 1963-31 Dec. 1963

M. Arnum Jan. 1964 30 p
(Contract NObsr-89503)
(SFD-33-IDR-2; AD-429347)

Circular versions of slow wave structures capable of meeting the required specifications of the program have been evaluated at cold test. Major emphasis has been placed on obtaining comparative electronic-interaction impedance values for the circuits and on obtaining an acceptable impedance match for the circuits across the frequency band of interest. Of particular significance is the fact that an interdigital line design with increased coupling impedance in comparison to that of the conventional interdigital line has been obtained. Construction of a second version of such a circuit has been initiated. Author

N64-19868 Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
PHASED ARRAY STUDY Interim Development Report, 1 Oct. 1963-1 Jan. 1964
L. Stark et al 31 Jan. 1964 68 p refs
(Contract NObsr-89427)
(FR-64-14-17; AD-428897)

The 180°-phase bit was designed and tested. A new circuit technique, called the transformed switch circuit, was investigated theoretically and proved to be superior to the conventional method of switching line sections. The transformed switch circuit was used in the design of the shorter phase bits. Active element patterns of the 10-element array were taken for various ground plane spacings. Author

N64-19871 Cornell U., Ithaca, N.Y. School of Electrical Engineering
REALIZATION OF TRANSFER FUNCTIONS ON RC: TUNNEL-DIODE NETWORKS [Technical Report 78, Feb.-Jul. 1963]
David L. Losee Oct. 1963 65 p refs
(Contract AF 33(657)-10682)
(EE-574; ASD-TDR-63-860; AD-429117)

It is seen that the use of tunnel diodes in RC network synthesis allows realization of arbitrary transmission zeros by means of grounded RC networks. The tunnel diode may be employed either to improve on the gain obtainable by passive realization techniques, or to obtain transfer functions that are neither RC-cascade nor RC-ladder realizable. A ladder network synthesis of positive real axis zeros is given realizing arbitrary gain. A cascade synthesis for right half-plane zeros is developed. It is shown that one tunnel diode, embedded in a network consisting of two paralleled RC ladders, is sufficient to realize any arbitrary transmission zeros. The diode requirements for this last realization are minimized. Brief consideration is given to the practical aspects of RC-tunnel diode synthesis. Author

N64-19901* IIT Research Inst., Chicago, Ill. Armour Research Foundation
ELECTRICAL CONTACT MATERIALS FOR SPACE VEHICLE SYSTEMS, PHASE I
W. H. Graft and J. L. Radnik Jan. 1962 45 p refs
(NASA Contract NAS8-2443)
(NASA CR-53901) OTS: $4.60 ph

A literature survey on electrical contact materials was performed to determine present practices in the specification of materials for low-level electrical contacts. Special emphasis was placed on material properties, and methods for evaluation of low-level contacts. The literature review comprises Phase I of a study and experimental investigation to determine the most suitable contact materials for use in connectors and contacts for space vehicle systems, as well as ground support equipment. A brief analysis of the weather parameters in the Cape Canaveral region was also carried out. The ideal material for low-level contacts must be tarnish-free and corrosion-free and have high conductivity; it must have a low coefficient of friction to minimize insertion and withdrawal forces. Gold meets these requirements well for most applications, particularly as a plating material. Hard gold alloys are often used to obtain satisfactory wear properties at lower cost. Even with gold plated contacts, corrosion failures can occur because of the porosity of most commercial plates, and the possible diffusion of base metal to the surface. Author

N64-19929 Harry Diamond Labs., Washington, D.C.
SOME UNIQUE DESIGNS OF MICROWAVE FERRITE PHASE SHIFTERS
H. Jones and F. Reggia 30 Dec. 1963 17 p refs
(TR-1189; AD-428429)

Several unique types of microwave ferrite phase-shifter designs are described. Each type offers certain distinct advantages when used in the laboratory and in microwave systems. The most salient feature of these low-loss devices is the design compactness consistent with optimum electrical performance. The electrical characteristics of these phase shifters and their components are given. These characteristics show that as much as 500° of phase shift can be achieved in X-band with 1-in. spacing between input and output ports. In each case, only a small magnetic field strength is required to obtain the desired phase shift. Other features of these ferrite devices include simplicity in construction, low cost, and small physical size. Author

N64-19948 Harvard U., Cambridge Cruft Lab.
A STUDY OF CIRCULAR ARRAYS. RADIATION PATTERNS AND CURRENT DISTRIBUTIONS
Richard B. Mack 1 May 1963 182 p refs
(Contract Nonr-1866(32))
(Tech. Rept. 383; AD-428780)

Measured radiation patterns and current distributions are compared with the results computed from the quasi-zeroth-order theory for a single antenna and arrays of five antennas. Antennas with half-lengths at a constant radius, as well as several different driving conditions, were used. Agreement between theoretical and measured currents is best for h/λ = 0.5000 and 0.3750. Circular arrays with one driven element radiate very little power in the backward direction if the elements are located near the resonant spacings. Agreement between theory and experiment is poorer near these spacings. The endfire couplet consisting of two antennas separated by $\lambda/4$ with driving-point currents 90° different in phase gives the cardioidal pattern predicted by zeroth-order (sinusoidal) theory only when h/λ is not much greater than 0.2500. Experimental results are correctly predicted by quasi-zeroth-order theory. When two antennas are fed with equal amplitudes but a 180° difference in phase, the power gain of the array increases and the beamwidths decrease as the separation between the antennas decreases. Author

N64-19951 Westinghouse Electric Corp., Washington, D.C.
500 WATT SILICON POWER TRANSISTOR First Quarterly Report, 31 Jul.-30 Oct. 1963
[1963] 40 p refs
(Contract NObsr-91001)
(AD-429319)

A method of testing power transistors for secondary breakdown behavior is described. Test results obtained on transistors manufactured by several different processes are discussed. It was found that secondary breakdown occurs in the collector-base connection as well as in the collector-emitter mode. Test

results are analyzed in terms of junction breakdown, avalanche-limited and punch-through limited transistor breakdown, and thermal runaway. Approaches to design of the subject transistor are evolved from consideration of test results. Author

N64-19962 Stanford Research Inst., Menlo Park, Calif.
COUPLED MODE THEORY FOR ADVANCED MICROWAVE DEVICES Interim Report No. 7
M. C. Pease and C. W. Barnes Jan. 1964 69 p refs
(Contract AF 33(657)-8343)
(AD-428055)

The purpose of this study is to develop and apply a generalized theory of the coupling of the modes of propagation such as occur in distributed microwave devices. A discussion is presented of periodic transmission systems, and it is shown how the Floquet theory can be formulated in terms of the language and concepts of coupled mode theory. The theory of coupled mode transmission systems with random coupling is extended to cover the case of a resonant transmission line. The usual class of nonuniform systems is considered, i.e., those systems described by a matrix, W, whose derivative is expressible as the commutator of W and some matrix S(z). A set of scalar invariants of the system are developed that are obtained from the properties of the underlying Lie algebra, and so are independent of the precise form of S(z). Some of the simpler algebras are given as examples, and some of their scalar invariants are derived. A numerical example is given to illustrate generally the power of Lie algebraic methods. Author

N64-19963 Fairchild Semiconductor Corp., Palo Alto, Calif. Research and Development Labs.
A DEVELOPMENTAL STUDY OF A HIGH FREQUENCY UNIPOLAR FIELD EFFECT TRANSISTOR Final Report, Jul. 1962-Sep. 1963
L. Ragle and M. Purnaiya Sep. 1963 43 p refs
(Contract AF 33(657)-8718)
(Rept. 4; RTD-TDR-63-4206; AD-428051)

The broad objective was to study the construction and performance of a very small active area field effect transistor. It was desired to make a high 100-mc input impedance, high-transconductance field effect transistor. The important experimental design considerations taken into account, together with fabrication problems that arose during the FET development, are discussed. Also discussed are the d.c. electrical characteristics obtained with two different geometries of field effect devices. These characteristics are related to the device geometry and diffusion structure to the extent that this is possible. The high-frequency characteristics of the device are described in terms of a Y-matrix characterization. An equivalent circuit model is derived, and performance is compared with design objectives. Author

N64-19969 Hughes Aircraft Co., Oceanside, Calif. Vacuum Tube Products Div.
RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE Interim Development Report, 24 Jun. 1963-1 Oct. 1963
P. P. Damon 5 Nov. 1963 37 p refs
(Contract NObsr-89452)
(AD-428609)

A direct view storage tube is being developed that is capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information. The operating principle is based on the fact that flood electrons that pass through holes in the storage mask when the storage-surface potential is near cutoff, fall within small areas on the viewing screen opposite the storage mask holes; whereas flood electrons, which pass through the holes when the potential is near its maximum, (i.e., flood gun cathode potential), fall on larger overlapping areas of the viewing screen. The viewing screen consists of two phosphors. One occupies small areas in register with the storage-mask holes, whereas the other occupies areas surrounding the first. Comparisons are made between the performance expected from this two-color tube and from a tube developed previously. Author

N64-19970 Tung-Sol Electric, Inc., Bloomfield, N.J. Research Lab.
HIGH SPEED POWER AMPLIFIER USING ELECTRON BEAM SWITCHED P-N JUNCTIONS Interim Development Report, 27 Sep.-26 Dec. 1963
17 Jan. 1964 27 p refs
(Contract NObsr-89493)
(AD-428020)

Experimental electron beam multiplier (EBM) tubes were made in which a diode pulse current of 2.0 amp was obtained at 50 to 140 v for a passivated silicon diode without heat sink, and 4.0 amp at 200 to 220 v for a bare junction silicon diode with heat sink. These values were obtained at less than rated beam current for the EBM. The anode potential was in the order of 20 kv. The pulse repetition rate was 100 pps. The pulse duration was approximately 1 μs. An electron gun was designed for the EBM tube to give 5-ma-beam current, a cutoff voltage of less than 20 v and a transconductance of 900 to 1,100 μmhos. The heat sink design was modified to facilitate diode assembly. Thermal resistance measurements indicate that the heat sink should adequately dissipate 60 w of power with no more than a safe temperature rise to 148° C. Author

N64-19978* Radiation Systems, Inc., Alexandria, Va.
RSI SATELLITE COMMAND ANTENNA ARRAY, MODEL 071-024. VOLUME I – ELECTRICAL Final Report
R. W. Hurlburt, Jr. 30 Aug. 1963 44 p ref
(NASA Contract NAS5-3142)
(NASA CR-55807; TR-35(U)) OTS: $4.60 ph

The electrical considerations used in the design of the RSI satellite command antenna array are described. Four of these arrays were designed, fabricated, and delivered. The disc-on-rod array has many advantages over a parabolic reflector. For example, if a parabolic reflector had been used, the reflector would have been 43 ft in diam. In addition the wind and ice loading on this structure would be significantly greater due to the low cross section of the array. The resulting requirements on the associated pedestal is correspondingly reduced. The basic 9-element array can be adapted to use as a monopulse tracking system. This modification would involve replacing the present polarization box with an interchangeable box containing the necessary RF hybrids and phase shifters. By the addition of an RF processing box and receivers, the antenna and pedestal can be converted into a self-contained precision tracking system. By using the basic array configuration, the number of elements could be either increased or decreased, depending on the given gain requirements. The single disc-on-rod element provides good gain, polarization diversity, and high power handling capacity with a lightweight structure. Author

N64-19980* Sperry Rand Corp., Norwalk, Conn. Sperry Semiconductor Div.
INTEGRATED MICROPOWER CIRCUITS Final Report, Mar. 7, 1963-Jul. 15, 1963
R. A. Tietsch et al [1963] 124 p
(NASA Contract NAS1-2619)
(NASA CR-53512) OTS: $10.10 ph

Initial investigations of various digital gate circuits were made using similar design conditions to determine relative performance characteristics over a wide range of power drains. Care was taken to obtain comparative performance by using the same semiconductor devices throughout the investigation. The most promising configurations were T^2L (direct coupled), DTL (single-transistor gate), and complementary RDTL (two-transistor complementary gate). Each family of configurations (gates, flip-flops, etc.) were investigated in detail over the temperature range of interest to further investigate comparative performance characteristics. Integrated component characteristics and the effect of various integration techniques on circuit performance were evaluated. Of the circuit configurations investigated, complementary RDTL offered the best overall performance characteristics. Author

N64-19981* Sperry Rand Corp., Norwalk, Conn. Sperry Semiconductor Div.
INTEGRATED MICROPOWER CIRCUITS Final Report Supplement
R. A. Tietsch, D. S. Dunavan and V. J. Capano [1964] 16 p
(NASA Contract NAS1-2619)
(NASA CR-53511) OTS: $1.60 ph

A discussion is presented of a circuit configuration that uses complementary RDTL logic. The considerations of a flip-flop d.c. set or reset, and a.c. sets and resets, are outlined. The possible use of a universal flip-flop and shifting accumulator is also considered. Power supply variations as a function of uniform and nonuniform nickel–cadmium battery drain discharge and their effect on circuit performance are considered. The effect of externally induced noise on the power supplies and circuit resistance variations is also discussed. The packaging requirements for a universal flip-flop and a NAND and NOR gate in a 10-pin flat package are considered. R.T.K.

N64-19987* Texas U., Austin Electrical Engineering Research Lab.
A 16 FOOT DIAMETER MILLIMETER WAVELENGTH ANTENNA SYSTEM, ITS CHARACTERISTICS AND ITS APPLICATION Technical Report No. 1
C. W. Tolbert, A. W. Straiton, and L. C. Krause Washington, NASA, 16 Mar. 1964 37 p refs
(NASA Grant NsG-432)
(NASA CR-53690; Rept. I-01) OTS: $3.60 ph

The efficiencies of the antenna at the frequencies of 35 and 94 Gc are 58% and 52%, respectively. The polar axis is precision driven at rates between 0.001° and 4° per minute and the polar and declination beam positioning accuracy is 0.01° rms in a 60° zenith cone angle. The parameter of observing will allow brightness temperatures to be determined within ±20%. Observations below altitude angles of approximately 45° (between meridian declinations of −15° and +80°) will suffer from absorption in the earth's atmosphere and therefore will be less accurate. The 70 Gc radiation temperatures of Jupiter and the Earth's Moon have been measured. The brightness temperature of Jupiter was 112° ±22° K, and the maximum brightness temperature contour of the Moon was 270° K. Relatively higher emission temperatures are observed from the maria and the craters of Copernicus and Tycho than from surrounding areas. Author

N64-19991* Ohio State U. Research Foundation, Columbus Antenna Lab.
THE ADMITTANCE OF APERTURE ANTENNAS RADIATING INTO LOSSY MEDIA
R. T. Compton, Jr. (Ph.D. Thesis) 15 Mar. 1964 100 p refs
(NASA Grant NsG-448)
(NASA CR-53849; Rept. 1691-5) OTS: $8.60 ph

The radiation of aperture antennas into lossy media is discussed. The infinite slot in a ground plane, and the rectangular aperture in a ground plane are considered. The object of the study is to determine for each antenna the admittance as a function of the electrical constants of the lossy medium. For each antenna configuration, two problems are treated. First, the antenna is assumed to radiate into a lossy half-space, and second, the antenna is assumed to radiate through a lossy slab into a free-space region. For each case, the aperture admittance is calculated as a function of the complex propagation constant of the lossy medium and the aperture dimensions. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-19306 Cincinnati U., Ohio
THEORETICAL OPERATING RANGES AND CALIBRATION RESULTS OF THE ARL TWENTY-INCH HYPERSONIC WIND TUNNEL Interim Technical Report, Feb. 1962–Jun. 1963
F. R. Tepe, Jr., D. L. Brown, K. L. Token, and W. Hoelmer Wright-Patterson AFB, Ohio, ARL, Oct. 1963 42 p refs
(Contract AF 33(616)-8453)
(ARL-63-189; AD-437320) OTS: $4.60

Results of calibration tests conducted in a 20-in. hypersonic wind tunnel are presented. Included in these tests are total pressure surveys, total temperature surveys, and blockage tests of various model configurations. All tests were conducted with the nominal Mach 14 throat installed in the tunnel. The total temperature survey was carried out in a direction normal to the flow at a fixed axial station, with the total pressure survey being conducted in the normal direction also, but at various axial locations. The models used in the blockage tests included hemisphere cylinders of various sizes and a 20° included angle cone. Author

N64-19474 ACF Industries, Inc., Paramus, N.J. ACF Electronics Div.
RHO/RHO COMPUTER DISPLAY Final Engineering Report
H. Hammerstein Nov. 1963 28 p
(Contract FAA-ARDS-563)
(RD-64-10)

The Rho–Rho Computer Display is a combined pictorial display and course-line computer operating from three DME inputs. Its place in the overall pictorial display evaluation program is merited by the higher accuracy of DME as compared with previous VORTAC pictorial displays. The equipment uses several design techniques for realizing the inherent accuracy of the input data; among these are slant range correction, use of sophisticated station-selection circuitry to automatically and continuously select the two stations yielding tracking data of the highest accuracy, ambiguity-resolution circuits, and use of high grade components. The Rho–Rho Display, when compared with the Rho–Rho–Theta Display, is favored. Author

N64-19661 Radio Corp. of America, Burlington, Mass.
INVESTIGATION IN DESIGN OF MAINTENANCE FACILITY FOR AN/TSQ-47
James J. Lauginiger, Gerald E. Surette, and Herbert W. Varley
Bedford, Mass., Electron. Sys. Div., Jan. 1964 137 p refs
(Contract AF 19(628)-490)
(ESD-TDR-64-198; AD-438174)

This report analyzes and discusses reliability, maintenance, and AGE reports in anticipation of assuring adequate support for an extended deployment from 30 days to 90 days. It analyzes the current available test data to complement the maintenance facility with additional test equipment and/or spare parts to produce a more effective maintenance facility for the system. The AN/TPS-35 and AN/TPN-14 subsystems and the associated microwave links are investigated for feasible autotest monitoring. Author

N64-19669 General Electric Co., Philadelphia, Pa.
PROPELLANT STORABILITY IN SPACE Third Quarterly Report, 1 Feb.-31 Mar. 1964
R. Carr, A. Cohen, C. Lankton, and B. Zeldin Edwards AFB, Calif., Rocket Propulsion Lab., Apr. 1964 28 p refs
(Contract AF 04(611)-9078)
(RPL-TDR-64-56; AD-437581)

Presented are the details of preparation for the second series of tests in the solar environmental simulator. Results of this test are given and compared with those obtained in the first test. In terms of steady-state data, the second test yielded excellent results. The numerical information indicates that insulated tankage systems do not perform as well as predicted, but give adequate protection for long term storage. It is also evident that the performance of large tanks is superior to that of smaller units. Author

N64-19675 de Florez Co., Inc., Englewood Cliffs, N.J.
THE DEVELOPMENT, APPLICATION, AND STUDY OF THE POINT LIGHT SOURCE TECHNIQUE Final Engineering, Operation, and Maintenance Report, Mar. 1961-Oct. 1962
George Puller Sep. 1963 112 p
(Contract Nonr-1628(00))
(Tech. Rept. NAVTRADEVCEN 1628-16; AD-435547)

A description is given of a device, 2-FH-4, that is a generalized flight-simulation device for flight-training research. This device was designed and developed to provide a research, development, and evaluation tool for studying the problems associated with flight simulators requiring visual presentation. The principal components of the device are the projector, hydraulic station, and the Cartesian coordinate plotters with their associated power servosystem. The projector (and its associated screen) presents to the pilot a visual picture of the surrounding terrain, and also, by virtue of projector motion, creates the illusion of flight relative to the depicted terrain. R.T.K.

N64-19713 Sandia Corp., Albuquerque, N. Mex.
STANDARD ENVIRONMENTAL TEST METHODS
R. W. Henderson Feb. 1963 92 p refs
(SC-4452B(M); supersedes SC-4452A(M))

Minimum requirements in the form of process standards covering the instrumentation, equipment, and methods to be used in conducting environmental tests on components are set forth. General guidance is included to help design, development, and test personnel achieve uniformity of testing. A check list for preparation of the environmental testing portion of product specifications is also included to promote uniformity of specifications. Author

N64-19734 Lessells and Associates, Inc., Waltham, Mass.
ACQUISITION AND ANALYSIS OF ACCELERATION DATA Third Progress Report
F. C. Bailey, D. J. Fritch, and N. S. Wise Washington, NAS-NRC, 17 Feb. 1964 71 p refs
(Contract NObs-88451)
(SSC-159; AD-430742)

Seven accelerometers and an unmanned recording system were installed aboard a dry cargo vessel, and data were obtained over a period of 15 months. The purpose is prediction of extreme values of acceleration encountered by cargo in the vessel over long periods of time. The data acquisition system operated satisfactorily with 90% efficiency. Analysis was based on data accumulated for 30 minutes every 4 hours. Analysis of wave-induced accelerations using a probability analyzer resulted in a maximum observed acceleration (bow, vertical) of 1.76 g peak-to-peak. Slamming or pounding resulted in 10 cps accelerations in excess of 3 g peak-to-peak. The peak accelerations observed under conditions of "slam" or "pound" were the result of hull vibrations and were excited by the second order of propeller blade excitation. While the maximum accelerations from "slams" and maximum wave-induced accelerations occur in the same time interval or under the same sea conditions, these maxima are not additive since the slam-induced maxima occur when the wave-induced accelerations approach zero. Author

N64-19788* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
ON THE POSSIBILITY OF SIMULATING METEOROID IMPACT BY THE USE OF LASERS Topical Report
William J. Rae and A. Hertzberg Apr. 1964 44 p refs
(NASA Contract NAS3-2536)
(NASA CR-54029; CAL-AI-1821-A-1) OTS: $4.60 ph

This report discusses the possibility of studying the problem of meteoroid damage by using a laser to simulate the conditions of high-speed impact. The characteristics of the light output from a laser allow a strongly focused pulse of energy to impinge on the target surface. The principal content of the report is a critical examination of the extent to which such irradiation simulates the conditions of impact by a solid projectile. The present state of knowledge concerning meteoroid-impact damage is briefly reviewed, and the capabilities of a laser are examined. Author

N64-19816 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Med. Research Labs.
AEROSPACE ENVIRONMENT SIMULATOR Technical Documentary Report, Nov. 1957-Mar. 1962
Otto Schueller and Fred W. Berner Feb. 1964 45 p refs
(AMRL-TDR-64-6; AD-438047)

Human tolerances and adaptability to low-pressure atmospheres and the direct utilization of the body's heat control and cooling mechanisms have yet to be fully exploited. Modified existing altitude chambers and clima-chambers with pressure, temperature, and humidity control can be used to study some of the basic functions of the human body in these areas. The problem of personal pressure protection and heat control in space cannot be solved by present research techniques. The small volume available in a skintight spacesuit or in a small space-worker capsule provides superior experimental results. Existing physiological altitude test chambers are inadequate. In balloon laboratories, the atmospheric pressure is too high to eliminate the thermal conductivity of the air, and the large balloon prevents accurate study of radiative heat exchange with the black sky. The AEDC environmental chambers used for testing full-scale aerospace vehicles and vehicle components do not

provide the versatility and safety required for testing of assemblies with human subjects, and are too large for economical operation in testing equipment and man. A small and versatile ground facility in which space environments can be simulated is recommended for its effectiveness and low cost. Author

N64-19938* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANISOELASTICITY TORQUE COMPENSATOR DESIGN FOR SATELLITE MOTION SIMULATORS
Hans F. Kennel and Paul T. Golley 11 Oct. 1962 41 p refs
(NASA TM X-51643; MTP-ASTR-N-62-12) OTS: $4.60 ph

Dynamic testing of the response of space-vehicle attitude-control systems requires a "satellite motion simulator" that has three degrees of angular freedom, is balanced at any angular position, and has frictionless support. Almost 90% of the unbalance torque was caused by anisoelasticity, and the remaining torques were due to nonsphericity of the air bearing and gravity gradient. A practical method of compensating these torques was accomplished by mounting cantilevered leaf springs with masses attached to the free ends on the simulator platform. A general solution for the compensation torque generated by the spring-mass combination was found and is presented in graphic and tabular form. The necessary parameters to design a suitable torque compensator can be obtained by matching the shape of an actual anisoelasticity torque curve with one of the normalized compensation torque curves given. The device was built and tested on the satellite motion simulator, and its effectiveness was proven by showing a decrease of 99% of the total unbalance torques. Author

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-19323 College of Aeronautics, Cranfield (Gt. Brit.)
A LAW OF THE WALL FOR TURBULENT BOUNDARY LAYERS WITH SUCTION OR INJECTION
T. N. Stevenson Jul. 1963 16 p refs
(CoA-AERO-166)

It is found from experiment that the law of the wall with suction and injection is

$$2u_\tau/v_w\{(1 + v_w u_1/u_\tau^2)^{1/2} - 1\} = 1/K \log_e y u_\tau \rho + A,$$

where A and K are independent of v_w and hence have values obtained for the case of no blowing. The equation is compared with experimental results. It is shown how the skin friction may be obtained from the velocity distribution for a given injection or suction velocity. Author

N64-19324 College of Aeronautics, Cranfield (Gt. Brit.)
A MODIFIED VELOCITY DEFECT LAW FOR TURBULENT BOUNDARY LAYERS WITH INJECTION
T. N. Stevenson Sep. 1963 21 p refs
(CoA-AERO-170)

It is shown by comparison with experimental results, that a modified velocity defect law for turbulent boundary layers with injection is

$$2u_\tau/v_w\{(1 + v_w u_1/u_\tau^2)^{1/2} - (1 + v_w u/u_\tau^2)^{1/2}\} = F\left(y/\delta\right).$$

where F is a universal function. The variation of skin friction with Reynolds number and the shear distribution are evaluated with the aid of this relation and are found to be in good agreement with experimental results. Author

N64-19367* Space Technology Labs., Inc., Redondo Beach, Calif.
AN INVESTIGATION OF NONLINEAR, NONPLANAR OSCILLATIONS OF FLUID IN A CYLINDRICAL CONTAINER
R. E. Hutton *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 191–199 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers
(NASA Contract NASr-80)
(NASA TN D-1870)

The steady-state planar motion of a fluid with a free surface, in a container undergoing lateral harmonic vibration, is not stable at all frequencies. This phenomenon was investigated analytically, and the theoretical findings were verified experimentally using a cylindrical container partially filled with water. Three types of fluid motion are involved in the studies—stable planar, stable nonplanar, and unstable motion. The analytical portion of this investigation assumes an incompressible, inviscid fluid in irrotational motion and as partially filling a cylindrical container that is being oscillated at a frequency in the immediate neighborhood of the lowest sloshing natural frequency. The associated boundary-value problem is solved for a steady-state solution that is valid through third-order terms in the free-surface wave height. P.V.E.

N64-19391 Cincinnati U., Ohio
THE INTERACTION OF UNEQUAL OBLIQUE SHOCK WAVES IN A HYPERSONIC FLOW Interim Technical Report, Aug. 1962–May 1963
F. R. Tepe, Jr. and W. Tabakoff Wright-Patterson AFB, Ohio, Aerospace Res. Lab., Aug. 1963 82 p refs
(Contract AF 33(616)-8453)
(ARL-63-146; AD-437271) OTS: $8.10

This report investigates the interaction of oblique shock waves of different intensities in a hypersonic flow both from the theoretical and experimental viewpoints. The primary purpose of this study is to predict the angle with respect to the free-stream flow direction of the vortex layer or contact surface that is generated by this interaction phenomena. Theoretical inviscid and viscous solutions were programed on the IBM 7090 computer for a range of Mach numbers from 6 to 20 and a range of flow deflection angles between 2° and 30°. In addition, empirical relations are developed to predict this contact surface angle with a minimum of computation, if a high degree of accuracy is not required. The three methods of solution are then compared and recommendations made as to under what conditions each is applicable. In addition, the effect of the variation of the various flow and geometric parameters on the viscous solution is considered. Author

N64-19553 General Applied Science Labs., Inc., Westbury, N.Y.
A FINITE DIFFERENCE METHOD SOLUTION OF NON-SIMILAR, NON-EQUILIBRIUM AIR, LAMINAR AND TURBULENT BOUNDARY LAYER FLOWS, PART I: ANALYSIS Final Report

Lawrence S. Galowin and Harry E. Gould 13 Mar. 1964 50 p refs
(Contract DA-30-069-ORD-3531; ARPA Order Nos. 51-60, 51-61, 51-62; Proj. Defender)
(Tech. Rept. 422; AD-435827)

Obtaining solutions for the governing differential equations for nonsimilar, chemically reacting laminar and turbulent boundary layers about axisymmetric and two-dimensional bodies was investigated. For application of numerical methods using finite difference techniques, the von Mises (streamline) coordinate transformation was introduced. The algebraic formulation resulting from the difference equations and stability restrictions upon allowable stepsizes were developed. Representative turbulent diffusivity models based upon the law of the wall, a full-eddy viscosity expression, a wake-like viscosity representation, and laminar viscosity contribution were introduced for the computer program. Arbitrary, but constant, dimensionless Prandtl, Lewis, Schmidt numbers, and also a ratio parameter involving the diffusion coefficient for each species, were introduced. The thermodynamics and chemical kinetic data of dissociated air species O_2, O, N_2, N, NO, NO^+, and e^- were considered. Boundary-layer swallowing of a chemically reacting inviscid flow field behind highly curved shocks was included. Author

N64-19554 General Applied Science Labs., Inc., Westbury, N.Y.
A FINITE DIFFERENCE METHOD SOLUTION OF NON-SIMILAR, NON-EQUILIBRIUM AIR, LAMINAR AND TURBULENT BOUNDARY LAYER FLOWS, PART II: COMPUTER PROGRAM Final Report
H. E. Gould and L. S. Galowin 13 Mar. 1964 139 p
(Contract DA-30-069-ORD-3531; ARPA Order Nos. 51-60, 51-61, 51-62; Proj. Defender)
(Tech. Rept. 422; AD-435828)

A program is presented for a numerical solution by an explicit finite difference technique of the momentum, species conservation, and energy equations for a chemically reacting laminar or turbulent air boundary layer. Presently, 7 species are included: O_2, O, N_2, N, NO, NO^+, e^- with the capacity to expand to 15. Laminar and turbulent effects in any of the equations can be made or withheld. Various viscosity models can be applied to the entire thickness of the boundary layer or the boundary layer can be segmented and different viscosity models applied to each of the segments. Provision has also been made for boundary-layer swallowing of new external streamlines, which depend upon the injested mass flow. Author

N64-19614* California Inst. of Tech., Pasadena
SECONDARY INJECTION OF GASES INTO A SUPERSONIC FLOW
Edward E. Zukoski and Frank W. Spaid Oct. 1963 70 p refs
(NASA Contract NAS7-100)
(NASA CR-53817) OTS: $6.60 ph

The flow field around the injection port for secondary injection of a gas into a supersonic stream has been studied experimentally. New information concerning pressure fields, concentration fields, and shock shapes is presented. A scale parameter has been calculated, based on a simple, inviscid model of the flow field. This scale parameter gives a good general correlation of the data. Use of this scale parameter allows prediction of a simple scaling law for the side forces generated by secondary injection. This side force scaling law is in approximate agreement with existing rocket motor test results. Author

N64-19625* General Applied Science Labs., Inc., Westbury, N.Y.
THE LAMINAR BOUNDARY LAYER IN HYDROGEN-AIR MIXTURES WITH FINITE RATE CHEMISTRY
P. A. Libby, H. Rosenbaum, and S. Slutsky Nov. 1963 83 p refs
(NASA Contract NAS8-2686)
(NASA CR-53633; Tech. Rept. 385) OTS: $8.10 ph

An analysis is presented of the compressible laminar boundary layer with an external stream of air of uniform velocity and with hydrogen fuel present in the flow. The transport processes were simplified by considering the $\rho\mu$ product at each streamwise station to be independent of the normal coordinate, and by assuming all Prandtl and Lewis numbers equal to unity. Finite rate chemistry is treated in detail. Nitrogen was assumed to be an inert diluent and 8 forward and 8 reverse-reaction steps of the hydrogen–oxygen system have been employed. An implicit finite difference method of solution was developed. Numerical solutions for diffusive flows are presented. Difficulty was encountered in cases of energetic chemical reaction. Author

N64-19635 Princeton U., N.J.
DETERMINATION OF THE SOLID PHASE VELOCITY IN A TURBULENT GAS-SOLIDS PIPE FLOW
R. Eichhorn, R. Shanny, and U. Navon Charlottesville, Va. U., School of Eng. and Appl. Sci., Mar. 1964 42 p refs Presented at the 2d All-Union Conf. on Heat and Mass Transfer, Minsk, BSSR, 4–10 May 1964
(Contract Nonr 3623(00); Proj. Squid)
(PR-107-P; AD-434473)

A description is given of the development of a new type of probe, employing optical fibers, for the determination of the velocity of solid particles in a two-phase gas-solids flow. The application of this probe to a turbulent pipe flow, comprising a suspension of 200μ glass beads in air, yielded the distribution function for the longitudinal velocity as well as the mean velocity, mass flux, and concentration profiles. Results are reported for measurements made at two separate axial locations for single values of the Reynolds number and mass flux ratio. Author

N64-19636 Princeton U., N.J.
EXPERIMENTS ON THE LIFT AND DRAG OF SPHERES SUSPENDED IN A POISEUILLE FLOW
R. Eichhorn and S. Small Charlottesville, Va. U., School of Eng. and Appl. Sci., Feb. 1964 37 p refs Submitted for Publication
(Contract Nonr 3623(00); Proj. Squid)
(Tech. Rept. PR-106-P; AD-434449)

An experimental investigation of the fluid dynamic forces on spheres suspended in a Poiseuille flow was performed. Small spheres of polystyrene, nylon, and lucite, having diameters ranging from 0.061 in. to 0.126 in. were suspended in Poiseuille flows in a 0.419-in.-diam tube. Variations in particle size and density, the fluid properties, and the angle of inclination of the tube resulted in a sphere Reynolds number (based on particle diameter and approach velocity) ranging from 80 to 250. The results are presented as curves, which include the coefficients of lift and drag plotted versus Reynolds number and a dimensionless shear parameter. Author

N64-19648 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
BOW-SHOCK STRUCTURE AND SLIP EFFECTS IN LOW-DENSITY HYPERSONIC FLOW
H. K. Cheng and A. L. Chang Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Feb. 1964 45 p refs
(Contract AF 33(616)-7812)
(ARL-64-26; AD-436803)

Hypersonic plane and axisymmetric flows around simple blunt shapes are treated within the framework of the Navier–Stokes equations, assuming a high compression ratio across the shock transition zone. The disturbed flow field is treated in two thin adjoining regions: the shock layer and the shock-transition zone. The present investigations provide an analytical solution for the structure of the bow shock and analyses of slip and temperature jump, as well as other higher-order effects. The formulation based on the two layers is shown to be consistent with the asymptotic expansion solution of the Navier–Stokes equations for high shock compression ratio and high Reynolds numbers. The present formulation provides uniformly valid approximations to the tangential velocity, temperature, streamline pattern, and other properties of the whole flow field. The analysis of the structure of the bow shock takes into account the influence of the downstream flow nonuniformity on the shock profile. Author

N64-19716 Advisory Group for Aeronautical Research and Development, Paris (France)
FLOW VISUALIZATION IN WIND TUNNELS USING INDICATORS
R. L. Maltby (Roy. Aircraft Estab.), comp. Apr. 1962 188 p refs
(AGARDograph-70)

This AGARDograph describes various flow-visualization techniques used in British wind tunnel practice not dealt with elsewhere. Emphasis is on techniques that have been developed during recent years—particularly those devised for the understanding of separated flows, including the vapor screen and surface oil flow techniques. Described are various techniques for locating boundary-layer transition, and smoke techniques for use in low-speed wind tunnels. Included in the AGARDograph are many references, and an extensive bibliography covering the complete range of indicator techniques. Author

N64-19723* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HYDROSTATIC STABILITY OF THE LIQUID-VAPOR INTERFACE IN A GRAVITATIONAL FIELD
William J. Masica, Donald A. Petrash, and Edward W. Otto Washington, NASA, May 1964 19 p refs
(NASA TN D-2267) OTS: $0.50

A study was conducted in a l-g acceleration field to determine the hydrostatic stability of the liquid–vapor interface in a cylinder. The result was a verification of the contention that the Bond number criterion is valid for predicting the regions of hydrostatic stability of the liquid–vapor interface. Factors affecting the stability of the interface are the specific surface tension of the liquid and the orientation of the interface with respect to the acceleration. Author

N64-19741 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXPERIMENTAL RESEARCH OF THE HYDRODYNAMICS OF A TURBULENT FLOW OF AIR IN THE GAP BETWEEN ROTATING COAXIAL CYLINDERS
S. I. Kosterin, Yu. A. Koshmarov et al 4 Mar. 1963 12 p refs Transl. into ENGLISH from Inz.-Fiz. Zh., Akad. Nauk Belorusskoi SSR (Minsk), v. 5, no. 5, May 1962 p 15–20
(FTD-TT-63-18/1+2; AD-299664)

Results are presented for experimental research on the flow of air in the ring channel between a rotating inner cylinder and a stationary outer one. Boundaries are established for the flow regions of the various systems. The experimental measurements of the losses by friction are presented. Author

N64-19763 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BOUNDARY LAYER WITH PRESSURE GRADIENT IN COMPRESSIBLE FLUID FLOW
V. Ya. Shkadov 31 Jan. 1964 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Mekhan. i Mashinostr. (Moscow), no. 2, 1963 p 28–32
(FTD-TT-63-1138/1+2; AD-433483)

The problem of the boundary layer in a compressible fluid is considered. The assumption is made that the viscosity depends linearly on the temperature and that the Prandtl number is constant. Information is presented on the following: (1) the distribution of the coefficient of friction over the surface of a cylinder; and (2) the distribution of the heat transmission over the surface of a cylinder. R.T.K.

N64-19781 Rensselaer Polytechnic Inst., Troy, N.Y.
FLOW PROPERTIES OF PHENOLIC RESIN INTERMEDIATES
David P. Stricos (Ph.D. Thesis) Jun. 1963 127 p refs

The flow behavior of resoles was examined using a cone and plate viscometer. The behavior was consistent with a proposed intermolecularly hydrogen-bonded system. Resoles are non-Newtonian in flow, exhibiting shear thinning. No time dependent flow properties were observed. The energy of activation for viscous flow decreases with increasing shear rate. From the magnitude of this decrease and Hirai's equation for the energy of link formation of vitreous materials, an estimate of the energy of formation of the intermolecular linkages was obtained. Plots of shear stress versus rate of shear are in qualitative agreement with the flow equation derived by Storey and Merrill and that derived by Gillespie. Both equations predict that the flow curve is linear at high shear rates. Intermolecular hydrogen bonding is significant in setting phenolic resins. Author

N64-19808 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BASIC PROBLEMS OF THE THEORY OF LAMINAR FLOWS
S. M. Targ 9 Jan. 1964 68 p refs Transl. into ENGLISH from the book "Osnovnyye Zadachi Teorii Laminarnykh Techeniy" Moscow, Gos. Izd. Tekh.-Teor. Lit., 1951 p 3–6, 268–313
(FTD-TT-63-817/1+2+4; AD-428910)

The following are discussed: (1) steady flow of a viscous fluid in plane and conical nozzles—radial flow in a nozzle, and flow in a conical nozzle; (2) development of a viscous-fluid flow in a plane diffuser—approximate equations of motion and their integration, investigation of the nature of flow in a nozzle, and flow in a plane tube; and (3) development of a viscous-fluid flow in a conical nozzle—approximate equations of motion and their integration, and investigation of the nature of flow in a conical nozzle. R.T.K.

N64-19937 Advisory Group for Aeronautical Research and Development, Paris (France)
WALL PRESSURE FLUCTUATIONS UNDER TURBULENT BOUNDARY LAYERS AT SUBSONIC AND SUPERSONIC SPEEDS
G. M. Lilley (Coll. of Aeron., England) Apr. 1963 57 p refs
(AGARD-454)

The theory of wall pressure fluctuations in incompressible flow is reviewed, and shows how the character of the pressure fluctuations changes in passing from the flow to the wall. The more important interactions giving rise to the pressure fluctuations are emphasized, as well as to the region of the boundary layer mainly responsible for the wall pressure fluctuations. The effects of compressibility are included. An analysis similar to that of Phillips is appropriate; this new treatment is not restricted to the case of very high supersonic Mach numbers. The

analysis makes use of the ratio a_w/u_τ as a large parameter, where a_w is the speed of sound at the wall and u_τ is the shear velocity. This is true for a very wide range of Mach numbers, provided the wall is not subjected to large rates of heat transfer. The wall pressure fluctuations become the result of fluctuations in both the vorticity and sound modes. At high Mach numbers, the latter contribution is in the form of eddy Mach waves. On making certain assumptions regarding the dominant interactions, estimates of the magnitude and spectrum of the wall pressure fluctuations are made showing similar trends to the measurements of Kistler and Chen. Author

N64-19946 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
THE SPECTRUM OF TURBULENCE IN AN EXOTHERMAL GAS FLOW Technical Report
Alan Q. Eschenroeder and Tung Chen Nov. 1963 88 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 347-63; Proj. Defender)
(TR63-217F; AD-426995)

The statistics of a locally isotropic turbulent field were investigated for a gas with a density-sensitive heating mechanism. A spectrally selective power source arose in addition to the usual external supply feeding energy into turbulence. Solutions of dynamic equations were obtained for the central region of the spectrum and for the viscous subrange. Spectral distortion in each case was measurable by the evaluation of a single parameter. The energy-containing region of the spectrum was strongly affected by the added effect of the distributed power sources. Moments of the power spectra were employed to assess the influence on collective properties of the eddy ensemble. Modifications are suggested for the usual methods of calculating the power flow, the turbulence Reynolds number, and the eddy diffusivity. A scaling law is suggested for calculating the spectral width. Author

N64-19968 Army Corps of Engineers, Portland, Ore.
FRICTION LOSSES IN ANNULAR FLOW
Nicholas A. Dodge N.Y., Am. Soc. of Mech. Engrs. [1955] 7 p refs Presented at Winter Ann. Meeting, ASME, Philadelphia, 17–22 Nov. 1963
(ASME Paper 63-WA-11) Available from ASME: $0.50 members, $1.00 nonmembers

This paper describes the resistance to flow through smooth eccentric and concentric annuli in the turbulent-flow regime and compares test results with previous investigations. Tests were run on three annuli with diameter ratios of 0.875, 0.750, and 0.688 in the Reynolds-number range of 20,000 to 100,000. From these tests an empirical expression for the friction factor, f, was developed for use with any setting of the core. The same method is applied to previous investigations in the smooth-pipe, turbulent-flow regime and is found to be in close agreement. Author

N64-19985* General Applied Science Labs., Inc., Westbury, N.Y.
GENERALIZED VISCOUS MULTICOMPONENT – MULTIPHASE FLOW WITH APPLICATION TO LAMINAR AND TURBULENT JETS OF HYDROGEN
Raymond Edelman, Harold Rosenbaum, and Simon Slutsky 5 Jun. 1963 91 p refs
(NASA Contract NAS8-2686)
(NASA CR-53509; Tech. Rept. 349)

A model is established for the continuum flow of a multicomponent system of gases and their condensed phases. The general conservation equations governing the behavior of the gases and condensed phases are derived. Viscosity, heat conductivity, diffusion, and production of species by chemical reactions are included in the development. Nonequilibrium phenomena associated with the presence of condensed phases are discussed in some detail. Preliminary application to the high-altitude hydrogen dumping process is made in an analysis and numerical calculation on a chemically frozen (diffusion controlled) axisymmetric jet in phase equilibrium. Author

N64-19989* General Applied Science Labs., Inc., Westbury, N.Y.
A PRELIMINARY ANALYSIS OF A REACTING BOUNDARY LAYER WITH COUPLED PRESSURE INTERACTION Technical Report No. 377
Raymond Edelman and Paul A. Libby Nov. 1963 49 p refs
(NASA Contract NAS8-2686)
(NASA CR-53631) OTS: $4.60 ph

An analysis was developed for a high-speed two-dimensional reacting laminar-boundary layer with coupled-pressure interaction. The external pressure is assumed to depend linearly on the slope of the displacement thickness in accordance with linearized supersonic theory. Simple transport properties are assumed with all Lewis and Prandtl numbers taken to be equal to unity. A moment method of solution is employed, which is an extension of the Karman–Pohlhausen integral technique and involves the use of the normal coordinate as a weighting function. Although a general analysis is presented, the treatment of the hydrogen-air system and of the zero and first moments of the conservation equations is carried forward in more detail. As might be expected a large system of first-order, nonlinear ordinary differential equations results from this treatment. Author

N64-19997* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TABLES OF FLOW PROPERTIES OF THERMALLY PERFECT CARBON DIOXIDE AND NITROGEN MIXTURES
William Patrick Peterson Washington, NASA, 1964 119 p refs
(NASA SP-3009) OTS: $2.50

This report presents equations, tables, and figures for use in the analysis of flow of carbon dioxide and mixtures of carbon dioxide and nitrogen. The analysis is restricted to conditions at which the gas can be assumed thermally perfect. Tables of gas properties as functions of temperature and one-dimensional, normal, and oblique-shock parameters as functions of Mach number are presented for 100-percent CO_2 up to Mach numbers 12.7; 50-percent CO_2 and 50-percent N_2 up to Mach number 11.5; and 10-percent CO_2 and 90-percent N_2 up to Mach number 10.4. The parameters dependent on Mach number are tabulated for stagnation temperatures of 1,000° R, 1,500° R, 2,000° R, 2,500° R, and 3,000° R. Condensation Mach numbers are also given for carbon dioxide and mixtures of carbon dioxide and nitrogen. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-19321 Kiruna Geophysical Observatory (Sweden)
KIRUNA GEOPHYSICAL DATA. DATA SUMMARY 63/2 APRIL–JUNE 1963
1963 54 p
(Partially supported by AFEOAR)

Tables and diagrams are given covering geomagnetic K-indices; ionospheric absorption of 27.6-mc cosmic noise; VLF radio-wave propagation at 16 kc between Rugby, England, and Kiruna, Sweden; satellite recording of 1961 Omicron I (Transit IV A); visible auroral index; and magnetic pulsations. R.L.K.

N64-19327 Joint Publications Research Service, Washington, D.C.
THE ORIGIN AND LINES OF DEVELOPMENT OF CONTINENTS AND OCEANS
V. A. Magnitskiy *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 1–45 refs (See N64-19326 12-28) OTS: $6.00

The origin of the continental and oceanic forms of the earth's crust is discussed. A comparison is made of the hypothesis of oceanic expansion due to continental subsidence and the hypothesis of oceanic expansion due to conversion of the oceanic type of crust into the continental type. It is concluded that although both these hypotheses meet with serious objections, and though neither can be considered as definitely proven or disproven, recent data concerning the ocean floor lend greater credence to the notion of continental growth. Author

N64-19328 Joint Publications Research Service, Washington, D.C.
RECENT DATA ON THE DETERMINATION OF THE ABSOLUTE AGE OF THE EARTH
V. I. Baranov *In its* Probl. of Cosmogony, Vol. VI 30 Apr. 1964 p 46–63 refs (See N64-19326 12-28) OTS: $6.00

Presented are the results of determinations of the absolute age of minerals, meteorities, and chemical elements, arrived at by radioactive methods. The absolute age of the earth itself can be estimated by these methods. The age of the earth lies between the limits of 3 billion years—the figure for the most ancient minerals—and 5 to 6 billion years—the figure for chemical elements. The age of the earth's crust is placed at 4 to 5 billion years. Author

N64-19412 Princeton U., N.J. School of Engineering and Applied Science
MECHANICAL PROPERTIES OF GRANULAR SYSTEMS
Scientific Report No. 1
Omar T. Farouki and Hans F. Winterkorn 1 Jan. 1964 101 p refs Presented at the 43rd Ann. Meeting of the Highway Res. Board, Natl. Res. Council, Washington, D.C., 13–17 Jan. 1964
(Contract AF 19(628)-2414)
(AFCRL-64-79; AD-436458)

The granular systems treated are devoid of interparticle cohesion, and the individual grains are independent of each other except for frictional interaction and geometric constraints incidental to the existing type of packing. The component particles may be of any size from the finest sand to pebbles, cobbles, or even boulders. Existing theoretical concepts are briefly presented, critically reviewed, and checked against a large number of available test data. Special attention is given to the "macromeritic state" concept that has been developed in analogy with accepted theories concerning the solid, liquid, and solution states of molecular assemblies. Author

N64-19425 Library of Congress, Washington, D.C. Aerospace Information Div.
PHENOMENA IN THE UPPER ATMOSPHERE. REVIEW OF SOVIET LITERATURE
26 Mar. 1964 18 p refs
(AID-P-64-16; AD-434205) OTS: $1.60 ph

Included in a discussion of Soviet developments in areas of astrophysics are the following: solar radiation and the ionosphere, atmospheric electricity, nuclear bursts in the atmosphere, satellite and missile data, and meteorology of the upper atmosphere. R.T.K.

N64-19473 Weapons Research Establishment (Australia)
A NON-EQUILIBRIUM INVESTIGATION INTO THE DIURNAL PHOTOCHEMICAL ATOMIC OXYGEN AND OZONE VARIATIONS IN THE MESOSPHERE
B. G. Hunt Feb. 1964 27 p refs
(WRE-TN-PAD-82)

A new investigation has been made into the diurnal photochemical variation of atomic oxygen and ozone in the mesosphere, for an oxygen atmosphere at rest, and for conditions prevailing at the equator. For the first time a complete diurnal study has been made keeping the equations controlling the atomic oxygen and ozone changes with time in their differential form and integrating them simultaneously by the Runge–Kutta method. This approach permits a nonequilibrium study to be made, and one result obtained was that photochemical equilibrium does not exist in the atmosphere above 60 km. The extent of the departure from equilibrium is given, and the diurnal variation of the atomic oxygen and ozone is illustrated. Author

N64-19480* California Inst. of Tech., Pasadena
EXPERIMENTAL GROUND AMPLITUDES FROM SMALL SURFACE EXPLOSIONS
Robert L. Kovach, Francis Lehner, and Ray Miller Repr. from Geophysics, v. 28, no. 5, Pt. 1, Oct. 1963 p 793–798 refs Presented at the 32nd Ann. Meeting of the SEG Sep. 1962 Calgary, Alberta
(NASA Grant NsG-535)

The ground amplitudes produced by the detonation of small untamped surface charges of Dupont's Nitramon S Primer and EL - 506 - PETN flexible sheet explosive were measured on a variety of rock types. For equivalent weights, the PETN sheet explosive produced larger ground amplitudes. Author

N64-19494 Council of Scientific and Industrial Research, New Delhi (India) Radio Research Committee
IONOSPHERIC PREDICTIONS FOR JUNE 1964
Jan. 1964 5 p
(RRC-B93)

The following are included: (1) predicted median values for the ordinary ray critical frequencies for the East Zone, (2) predicted median values for the maximum usable frequencies for 4000 km for the East Zone, and (3) nomogram for transforming F_2-zero-MUF (maximum usable frequency) to equivalent maximum usable frequencies at intermediate transmission distances; conversion scale for obtaining optimum traffic frequency (FOT). R.T.K.

N64-19579* Southwest Center for Advanced Studies, Dallas, Tex.
THEORY OF THE GEOMAGNETIC DAILY DISTURBANCE VARIATIONS
J. A. Fejer Repr. from J. Geophys. Res., v. 69, no. 1, 1 Jan. 1964 p 123–137 refs
(NASA Grant NsG-269-62)

The worldwide ionospheric current system predicted by a theory of the auroral electrojets is computed. Tidal air motions are neglected at first, and the high-latitude current system is assumed to be due entirely to the interaction of magnetospheric rotation with the belt of energetic protons trapped in the distorted geomagnetic field. In view of a limitation of the current system by the available electron concentrations, the large disturbance variations observed during an intense geomagnetic storm can be explained by the present theory only if, in addition to an enhancement in the trapped proton density, greatly enhanced E-region electron concentrations are assumed. The observed correlation between blanketing sporadic E and the strength of the electrojet current is thus predicted by the present theory. The present theory can also account for the generation of meridional static electric fields of the type that cause midlatitude red arcs. Author

N64-19652 Chalmers U. of Tech., Göteborg (Sweden) Research Lab. of Electronics
WHISTLER MODE – IONIZED STREAM INTERACTIONS, PART I
O. E. H. Rydbeck and J. Askne 1 Apr. 1963 56 p refs
(Contract AF 61(052)-451)
(Res. Rept. 18; AFCRL-64-80; AD-436810)

The transformation of a fast cyclotron wave to a backward whistler mode is probably a phenomenon in the exosphere. Less probable, but possible under restricted conditions, is a forward-traveling-wave-amplification mechanism. The paper also discusses the basic properties of a drifting ionosphere. The classical n^2 zeros are invariant with the drift velocity, and yield total reflection for a stationary medium only. The fourth reflection level ($n^2 = \infty$) disappears for the drifting medium. A number of graphs are presented, applicable also to plasma amplifier theory. Author

N64-19663 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
ACCURACY OF MEAN GRAVITY ANOMALIES OBTAINED FROM POINT AND PROFILE MEASUREMENTS Scientific Report No. 4
Helmut Moritz Dec. 1963 28 p refs
(Contract AF 19(628)-2771)
(Rept. 29; AFCRL-64-132; AD-436638)

Mean gravity anomalies for a certain rectangular area (block) can be computed from observed point or profile gravity values using an interpolation method (e.g., representation or least squares interpolation). If the covariance function of the gravity anomalies is known and the interpolation method is specified, it is possible to compute the accuracy (standard error and error covariance) of the mean anomalies without any additional numerical data. The formulas for this purpose are evaluated numerically for different sizes of blocks and different interpolation methods using an estimate for the covariance function. The integrals involved are approximated by summations performed by a high-speed computer. The results show the accuracies obtainable with a given observational material, by different interpolation methods. They are useful for numerical studies on the error propagation in the computation of gravimetric quantities (e.g., geoid undulations). Author

N64-19677 Defence Research Board, Ottawa (Canada) Defence Res. Telecommun. Estab.
PRESENT KNOWLEDGE OF THE LOWEST IONOSPHERE
J. S. Belrose *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 3–23 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Deductions about the physical parameters of the ionospheric D-region have usually been made indirectly by studying its effects on waves that have traversed it, reflected in layers above (MF and HF absorption measurements), or by studying waves returned from within it on a few isolated frequencies (IF and VLF propagation experiments). It is difficult to devise experiments giving direct evidence about electron distribution and collisional frequencies in the D-region. The best at present seems to be the partial-reflection experiment, which measures the ratio of the two magneto-ionic components scattered from discrete irregularities, and the ionospheric cross-modulation experiment, which measures the interaction between pulsed radio waves. Preliminary results provide support for some theories of the formation of the D-region, and suggest that the D-region contains at least two ionized layers. Differences in the daily formation and decay of these layers provide an explanation for certain features found in LF and VLF propagation. The current state of knowledge concerning the D-region is summarized. Author

N64-19678 Norwegian Defence Research Establishment, Kjeller
ELECTRON DENSITY PROFILES IN THE QUIET D-REGION DERIVED FROM OBSERVATIONS OF CROSS MODULATION
R. L. Barrington and E. V. Thrane *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 25–33 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Observations of pulsed cross modulation were made during quiet days in the spring, summer, and fall of 1960. A brief description of the experimental method is given. It was possible from these observations to establish a definite diurnal variation in electron densities between 60 and 80 km for quiet spring days. A small seasonal variation in the observations is interpreted tentatively as a seasonal change in the electron density profiles. The deduced diurnal variation is discussed in the light of theoretical predictions, which assume that cosmic rays and solar Lyman-α radiation account for the normal ionization in this region. Author

N64-19679 Naples U. (Italy) 1st. di Fiz. Tec.
ON SOME NEW PROPERTIES OF THE LOWER IONOSPHERE
M. Cutolo *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 35–42 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

The main nonlinear effects discovered in the ionosphere (Luxembourg–Gargov effect, self-modulation, gyrointeraction, etc.) are dealt with. Due to the remarkable nonlinearity of the lower part of the ionosphere, the author thought that the plasma may behave as a "detector" separating the low frequency from the carrier of a modulated wave. The experiments carried out between 1953 and 1962 confirming that a detection effect does occur are referred to. Author

N64-19680 Naples U. (Italy) 1st di Fiz. Tec.
ANALYSIS OF CROSS-MODULATION BY V. A. BAILEY'S EQUATION
A. Pozzi *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 43–48 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

A method of evaluating the electronic collision frequency in the ionosphere is discussed. The author solves V. A. Bailey's equation and checks the accuracy of the proposed solution by comparison with an exact one. Also shown is how these

results can be applied to study the ionospheric properties by utilizing Cutolo's experiments. Author

N64-19681 Paris U. (France)
D-LAYER IRREGULARITIES AND THEIR EFFECTS ON THE WAVEFORM OF ATMOSPHERICS [LES IRREGULARITES DE LA COUCHE D ET LEUR EFFET SUR LA FORME D'ONDE DES ATMOSPHERIQUES]
J. Delloue and M. Garnier *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 51–60 refs In FRENCH; ENGLISH abstract (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Observation of the waveforms of atmospherics with two loops spaced an infinitesimal fraction of a wavelength apart, very often shows differences in induced signals that cannot be attributed to the equipment. The main characteristic of the phenomenon is its variability in form and time. At a frequency of 5,500 cps, amplitude ratios as large as 1/2 or 1/3 with no phase effect are observed, or phase differences, which can reach 0.3 rad without amplitude effect. Combined effects are also frequently recorded. The time scale of the events, although variable, is of the order of seconds. The use of an array of several loops shows that the effects are different for each loop. Simultaneous measurements conducted at sites 15-km apart showed no correlation in form or time of occurrence. When such anomalies are observed, the directions of arrival given by a crossed loop direction finder do not agree with the data obtained from two perpendicular 15-km-long bases. The patterns given by the crossed loops are then elliptical, and in many cases the long base equipment gives imaginary directions of arrival. These phenomena are attributed to D-layer irregularities producing focusing effects and interference patterns on the ground. Author

N64-19682 Navy Electronics Lab., San Diego, Calif. Radio Physics Div.
THE NATURE AND SCALE SIZE OF IRREGULARITIES IN THE D-REGION OF THE IONOSPHERE AS OBSERVED ON A NEAR VERTICAL INCIDENCE V.L.F. SOUNDER
Merle R. Paulson, Earl E. Gossard, and William F. Moler *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 61–72 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

The VLF ionospheric sounding system consists of a 30-kw phase stable CW transmitter, two horizontal half-wave dipole transmitting antennas aligned along and normal to the geomagnetic field, and three receivers capable of measuring phase and amplitude. Spaced receiver measurements have been made at 10, 13, 17, and 23 kc. Spectra of phase and amplitude fluctuations and the cross correlograms between phase and amplitude are presented. The drift direction and velocity of ionospheric inhomogeneities derived from cross correlations of fluctuation data between pairs of receivers are discussed. The reflection coefficients predicted by the full-wave solution of the wave equations for propagation in a continuous magnetoionic medium are compared with measured characteristics of the polarization ellipse of the downcoming wave. The profiles of electron density and collision frequency that give the best agreement between the theoretical and experimental results are discussed. Author

N64-19683 Stanford U., Calif. Radioscience Lab.
AN INTERPRETATION OF LOFTI-I V.L.F. OBSERVATIONS
Louis H. Rorden (Stanford Res. Inst.), R. L. Smith, and R. A. Helliwell *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 75–81 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7 (Contract Nonr-3267(00)(X))

During February and March of 1961, the Naval Research Laboratory LOFTI-I satellite received very low frequency signals transmitted into the ionosphere from U.S. Navy stations NBA in the Canal Zone and NPG in Jim Creek, Washington. The signals were sometimes observed to have been delayed by as much as 600 msec. It was possible to deduce the thickness (scale height) of the ionosphere above the height of maximum electron density. The values correspond roughly to those previously found from rocket measurements. Simultaneous daytime reception of both NPG and NBA showed an interesting difference in attenuation of the signal strengths such that the signal from NBA was more heavily attenuated. The difference can be explained by taking into account the tilt of the earth's magnetic field and the arrival of the NBA signal from the south and the NPG signal from the north. Author

N64-19684 Pennsylvania State U., University Park Ionosphere Research Lab.
STUDIES OF THE ECHO POLARIZATION FROM HIGH GRADIENT PROFILES
A. J. Ferraro and C. P. Tou *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 83–99 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

In a previous report, the phenomenon of interference fringes on swept low-frequency polarization records has been interpreted by Brunnschweiler as formed from two overlapping echoes. On further examination, this has been found to be inadequate to explain the phenomenon. In the present report, the interference fringes are interpreted as formed from the waves of two different modes reflected by a high-gradient sporadic layer in the E-region. This interpretation has shown satisfactory agreement with the experimental data. Author

N64-19688 Heinrich-Hertz-Institut, Berlin (W. Germany)
THE STATISTICAL FREQUENCY SPECTRUM OF ATMOSPHERICS
Hans Volland *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 169–173 (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

An instrument is described that has been developed for simultaneous counting of atmospherics at 11 different frequencies between 5 and 50 kc/s. The instrument is so constructed that the time of measurement at each frequency is the eleventh part of the whole time. The output recordings are made on magnetic tape. After the end of measurement, a counting machine is fed with the magnetic tape, and thus counts the atmospherics at the different frequencies. It is possible to repeat the counting at different thresholds of the counting equipment. The threshold is proportional to a minimum field strength that the atmospheric must possess to be counted. R.T.K.

N64-19689 Kiruna Geophysical Observatory (Sweden)
BAND EMISSIONS AT GYRO FREQUENCIES AND IONOSPHERIC IONS AND HISS FREQUENCIES
Georg Gustafsson, Alv Egeland, William Barron, and Jules Aarons (AFCRL) *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 175–189 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7 (Contract AF 61(052)-600)

The background noise level in the frequency range 10 to 10,000 cps has been monitored at Kiruna and Sagamore Hill. Three emission bands have been found centered at 33, 750, and 2,500 cps, respectively. The 33 cps and 750 cps bands have been found to be dependent on the latitude but not the 2,500 cps band. Different properties of the 750 cps emission and especially a case with good correlation with micropulsations are discussed. An analysis of the diurnal variation of the background noise level is made for several frequency bands. Author

N64-19690 Stanford Research Inst., Menlo Park, Calif.
CHARACTERISTICS OF VERY LOW FREQUENCY ATMOSPHERIC NOISE IN THE ARCTIC
A. L. Whitson *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 191–208 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £ 7 (Contract AF 19(604)-2409)

The amplitude distributions of sferics received at Fairbanks, Thule, and St. Johns from September 1958 through March 1959 have been determined. In the Northern Hemisphere, during the winter, the month-to-month variation in the rate of sferics exceeding a specific field strength decreases as the latitude of the receiving station increases. The source location data and data from received direction-of-arrival distributions correlate with reported thunderstorm-day contours throughout the world. The diurnal variation of sferic activity has been determined; for any geographical location in the middle latitudes, local sferic activity is a minimum in the morning and a maximum during the night, for the winter months. Atmospheric noise amplitude data indicate that atmospheric noise level as a function of frequency is dependent upon the latitude of the receiving station. Author

N64-19691 Taunus-Observatorium (W. Germany)
RECORDING ATMOSPHERIC V.L.F. RADIO NOISE AND DISTINGUISHING THEIR SOURCES [ENREGISTRATION DU "RADIO NOISE" DE L'ATMOSPHERE EN REGION DE V.L.F. ET LEUR COORDINATION AUX SOURCES]
G. Mattern *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 209–215 In FRENCH; ENGLISH summary (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Several results of observations of radio noise in the VLF region over a period of 5 years are given. It is possible to distinguish three sources of noise—parasites, whistlers, and extraterrestrial phenomena. Author

N64-19692 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
DIURNAL CHANGES IN THE TIME OF PROPAGATION OF V.L.F. WAVES OVER SINGLE MODE PATHS
W. T. Blackband *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 219–229 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

The following are discussed: (1) the diurnal change in transmission time; (2) the variation of the ratio of the change of transmission time to distance ($\Delta t/D$) with frequency; (3) single mode propagation on short paths; (4) the effect of transmission direction; (5) a comparison of land and sea paths; and (6) variation of $\Delta t/D$ with geographical latitude. R.T.K.

N64-19693 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE STATISTICAL PREDICTION OF DIURNAL PHASE CHANGES
D. E. Hampton and A. S. Hill *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 231–237 ref (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

An elementary physical model is presented that envisages that the height of the ozonosphere and the effective reflecting height of the ionosphere are the variable parameters. A family of curves based on these parameters are considered. By statistical methods, that curve which is the best fit to the experimental data is determined. The choice of the parameters and the closeness of the fit are discussed. R.T.K.

N64-19697 Pickard and Burns Electronics, Waltham, Mass.
PHASE ANOMALIES OBSERVED IN VERY LOW FREQUENCY PROPAGATION DURING NUCLEAR TEST OF JULY 9, 1962
R. H. Woodward and G. J. Gassmann (AFCRL) *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 321–333 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £ 7

Highly stabilized routine phase recordings of the VLF stations NPM, NPG, NBA, and GBR were taken near Boston, Massachusetts, U.S.A. The regular diurnal phase variations show a predictable pattern. The nuclear detonation of July 9, 1962, in the megaton range several hundred kilometers above Johnston Island, caused phase anomalies commencing within a few minutes. The effect on the recordings, except of NPG, lasted approximately 40 min, with a longer lasting effect of several hours superimposed. The effect on the NPG recording lasted only 10 min. The phase anomalies are thought to be caused by electrons dumped from the manmade radiation belt. Duration and magnitude of the effects are determined by geometry and by the nature of the two electron sources, the neutron decay, and the radioactive debris cloud. Author

N64-19699 Paris U. (France) Lab. de Phys. de L'Atmosphere
INFLUENCE OF THE CURRENT DISTRIBUTION OF LIGHTNING DISCHARGE ON THE ELECTROMAGNETIC RADIATION TO LONG DISTANCE [INFLUENCE DE LA REPARTITION DU COURANT DANS L'ECLAIR SUR SON RAYONNEMENT A GRANDE DISTANCE]
J. Papet-Lepine *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 341–350 refs In FRENCH; ENGLISH summary (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

An attempt is made to predict the influence of the nonuniform current distribution on the magnetic field at great distance (but less than 1,000 km). It is shown, in particular, that the influence on the spectrum of the field is such that it is not solely a function of the derivative of the current but is the sum of three spectra produced, respectively, by the three terms describing the nonuniform distribution. The coefficients of these terms depend on the local characteristics of the discharge. In calculating the field at a distance by using a nonuniform current distribution, spectra are obtained with the experimentally recorded waveforms of the received field, which are not explained by the classical (uniform current distribution) theory and which result in a bell-shaped spectrum having a maximum around 8 or 10 kc according to the rise time of the current. Author

N64-19700 Boeing Scientific Research Lab., Seattle, Wash. Mathematics Research Lab.
EXTREMELY LOW FREQUENCY MAGNETIC WAVES IN AN INHOMOGENEOUS HYDROMAGNETIC MEDIUM

W. C. Hoffman *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 351–360 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

An apparently new type of extremely low frequency wave motion of the magnetic field in an inhomogeneous hydromagnetic medium flowing about a conducting magnetized sphere is shown to exist under certain conditions upon the flow velocity, the conductivity, and their respective divergence and gradient. Satellite magnetometer data and the characteristics of geomagnetic micropulsations are discussed in relation to this theoretical model. Author

N64-19701 London U. (Gt. Brit.) Wheatstone Physics Lab.
THE INFLUENCE OF THE IONOSPHERE ON THE POLARIZATION OF V.L.F. AND E.L.F. RADIO WAVES

F. W. Chapman and D. G. C. Jones *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 361–369 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

Measurements of the polarization of atmospheric waveforms have been made in the frequency range 500 cps to 12 kcps, for propagation distances between 300 and 3,000 km. Using these results, the variation of polarization with distance and direction of propagation has been investigated. The theoretical problem of the propagation of radio waves in the earth–ionosphere waveguide has been examined with special reference to the calculation of theoretical values of polarization, and the relevant equations have been solved using a high speed digital computer. By comparing the theoretical values with those obtained experimentally at VLF, a model of the variation of electron density with height in the D-region of the ionosphere has been deduced. Comparison of the theoretical and experimentally measured values of polarization at ELF suggests that the main contribution to the horizontally polarized component of an atmospheric at frequencies below 1 kc is due to source effects. At frequencies above 1 kc the horizontally polarized component is mainly due to propagation effects. Author

N64-19702 Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France)
MAGNETIC RECORDS BETWEEN 0.2-30 C/S

Roger Gendrin and Robert Stefant *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 371–400 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

(Centre Natl. des Etudes Spatiales Contract 62-CNES-025)

A magnetometer was used that is designed to record and analyze the geomagnetic field fluctuations in the frequency range 0.2 to 30 cps. Between 5 and 30 cps the earth-ionosphere cavity resonances at 8, 14, 20, and 26 cps were obtained. Preliminary results about the diurnal variation of the intensity of the peaks are given. The effect of the high-altitude thermonuclear explosion, which produced a sudden lowering of the resonance frequencies, has also been analyzed, and some conclusions drawn. Between 0.2 and 3 cps, discrete oscillations, lasting from 20 min to 7 hr, are often observed. They are related to the "pearl pulsations" discovered by Troitskaya, or to the hydromagnetic emissions studied by Tepley. The fine structure of some of them has been obtained. They consist of trains of rapidly increasing frequency emissions, repeated at about 2-min periods. An empirical law, relating the mean frequency of the oscillation to this repetition time, is given. Author

N64-19703 Lincoln Lab., Mass. Inst. of Tech., Lexington
THUNDERSTORM EXCITATION OF THE EARTH-IONOSPHERE CAVITY

Martin Balser and Charles A. Wagner *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 403–411 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

(Supported by Army, Navy, and AF)

Early results of a program to study the spectrum of ELF radio noise in the band 5 to 30 cps were obtained by simulated filtering on a digital computer. This processing clearly revealed the peaks in the spectrum resulting from the responses of the first five resonant modes (Schumann modes) of the earth–ionosphere cavity. The measured diurnal power variations were found to correspond closely with mean worldwide thunderstorm activity, differences among the modes reflecting the characteristic geometrical configuration of each mode. More recently, this information has been used to build analog equipment to examine selected portions of the spectrum at greater length. Power variations of individual modes can now be displayed continuously. A systematic study is now underway of diurnal variations throughout the year as related to changing locations and intensity of thunderstorm activity. Author

N64-19704 London U. (Gt. Brit.) Wheatstone Phys. Res. Labs.
EARTH-IONOSPHERE CAVITY RESONANCES AND EFFECTIVE IONOSPHERIC PARAMETERS

F. W. Chapman and D. Llanwyn Jones *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 413–420 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

The cavity resonator region of the natural electromagnetic noise spectrum has been observed since June 1961 by means of an integrating spectrometer that sweeps the frequency range 4 to 40 cps in a period of one hour. The recorded spectrum shows that very often the resonance modes of the earth-ionosphere cavity can be detected. Very high levels of resonance were detected during the geomagnetically disturbed period in the summer of 1961. In general the level of resonator oscillations in the first order mode has been found to be some 20 to 200μv/sec m^{-1}. Mode frequencies up to the sixth order have been detected. From a knowledge of the resonance mode frequencies it is possible to determine approximate values of the ionospheric conductivity appropriate to extremely low frequencies. A diagram is presented that enables this parameter to be determined directly once the mode frequencies are known. Calculations show that the lower D-region of the ionosphere is effective in electromagnetic wave propagation at cavity mode frequencies. Author

N64-19705 Cambridge U. (Gt. Brit.) Cavendish Lab.
THE NATURAL E.L.F. ELECTROMAGNETIC NOISE IN THE BAND 2-40 C/S; APPARATUS AND SOME PRELIMINARY RESULTS

M. J. Rycroft and T. W. Wormell *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 421–434 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £7

A program of observations on radio noise in the frequency range from 2 to 40 cps is discussed. The experimental arrangements are considered in some detail, particular attention being paid to the devices for rejecting the unwanted manmade disturbances that are prominent at an ordinary site. Some preliminary results are presented, including power spectral densities of

sample records. These are in fair agreement with the published work of Balser and Wagner and show peaks that can be ascribed to the first few modes of the atmospheric cavity between earth and ionosphere that was discussed by Schumann. A sharply bounded, homogeneous, isotropic ionosphere of infinite extent is considered, and it is found that the observations are best fitted by assuming an effective height of 76 km. Author

N64-19706 Rhode Island U., Kingston
SOME RECENT MAGNETIC FIELD MEASUREMENTS IN THE EARTH-IONOSPHERE RESONANCE REGION
C. Polk *In* AGARD Propagation of Radio Waves at Frequencies Below 300 kc/s 1964 p 435–456 refs (See N64-19676 12-01) Pergamon Press and Mac Millan Co.: £ 7

Amplitude vs time records of 2-min duration of north–south and east–west magnetic field variations in the 5 to 20 cps frequency range, and 24-hr records of 7.5 to 10 cps magnetic fields, which were obtained over a period of several months, are analyzed. It appears that the most prominent frequency of individual wave trains in this frequency range is not constant, that some imperfect correlation exists between ELF noise and solar activity, and that 7.5 to 10.0 cps ELF intensity (recorded on an east–west coil) is normally higher during daylight hours than the corresponding ELF intensity recorded at night. The diurnal variation of ELF intensity averaged over a 75-day period between April and July 1962 closely resembles the diurnal variation of thunderstorm activity in the Western Hemisphere, based upon data accumulated before 1960. Author

N64-19718 Weapons Research Establishment (Australia) Defence Scientific Service
IONOSPHERIC DATA FOR DECEMBER, 1962 FROM SALISBURY, SOUTH AUSTRALIA
Dec. 1963 26 p
(Ionospheric Data Bull. CPD 1962/12(S))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for December 1962. Author

N64-19719 Weapons Research Establishment (Australia) Defence Scientific Service
IONOSPHERIC DATA FOR JUNE, 1963 FROM SALISBURY, SOUTH AUSTRALIA
Jan. 1964 26 p
(Ionospheric Data Bull. CPD 1963/6(S))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for June 1963. Author

N64-19720 Los Alamos Scientific Lab., N. Mex.
ENERGY DEPOSITION IN THE ATMOSPHERE BY DELAYED GAMMAS FROM FISSION
E. W. Bennett 24 Apr. 1964 18 p refs
(Contract W-7405-ENG-36)
(LAMS-3059) OTS: $0.50

Calculated source functions are provided for the determination of energy deposition in the atmosphere by delayed gammas from fission of U^{235} and U^{238}. The gamma spectra and the source strength for debris resulting from 1 kt of fission yield in each case are included. Calculations are done for both "good" geometry and "bad" geometry. Energy deposition rates are determined from 10^{-2} to 20 sec after fission and extrapolated as $t^{-1.2}$ for times > 20 sec. Author

N64-19738 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHODS FOR A DETAILED STUDY OF SEISMICITY [METODY DETAL'NOGO IZUCHENIYA SEYSMICHNOSTI]
V. I. Bunz, M. V. Gzovskiy et al 28 Feb. 1963 551 p refs Transl. into ENGLISH from Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR (Moscow), no. 9(176), 1960 327 p
(FTD-TT-62-269/1+2; AD-400507)

A description is presented of apparatus used in the detailed seismic investigations, of new methods for the large-scale determination of the coordinates of earthquake foci worked out on the basis of experience in seismic exploration, and of detailed methods for determination of the structure of the earth's crust on the basis of earthquake observations by a network of stations. Methods are described for determination of seismic energy, which allow for the extremely substantial influence of dissipation and absorption of energy, especially important in the epicentral zone. Estimates and computations are given for the parameters of earthquake foci and displacements in foci as functions of earthquake energy. A comparison is made of the spatial distribution of seismicity with the geological-tectonic structure of the region under investigation. P.V.E.

N64-19814 California U., Berkeley Space Sciences Lab.
COHERENCY OF GEOELECTROMAGNETIC SIGNALS
S. H. Ward and H. G. Fournier (Inst. de Physique du Globe de Paris, France) 6 Nov. 1963 19 p refs
(Contract Nonr-222(89))
(AD-428953)

By theory and observation it is possible to demonstrate that the coherency between orthogonal electric and magnetic time series used in magnetotelluric sounding is a function of (1) the direction of the measuring axes, (2) the anisotropy ratio, (3) the coherency between the orthogonal H components, (4) the relative magnitudes of the orthogonal H components, and (5) the frequency. Author

N64-19918 California U., Berkeley Space Sciences Lab.
GEOMAGNETIC BAYS – A REVIEW Technical Report
Rubén Zelwer 3 Dec. 1963 48 p refs
(Contract Nonr-222(89))
(*Its* Ser. 4, Issue 86; AD-428428)

The causes of geomagnetic bays are discussed from several points of view, including their classification, their frequency of occurrence, their frequency of variation, their order of appearance, their recurrence, and other characteristics. Previous research in this area is selected and summarized to gain an overall picture of a phenomenon as yet little known. G.D.B.

N64-19950 California U., Berkeley Space Sciences Lab.
THE STATE OF MAGNETO-TELLURICS IN THE SOVIET UNION [DER STAND DER MAGNETO-TELLURIK IN DER SOWJETUNION]
Gottfried Porstendorfer 3 Dec. 1963 29 p refs Transl. into ENGLISH from Bergakademie, Freiberg, (E. Germany), v. 3, 1963 p 235–242
(Contract Nonr-222(89))
(*Its* Ser. 4, Issue 85; AD-428605)

The following are discussed: (1) the theory of magnetotelluric work—condition for asymptotic formulas; theory of magnetotelluric fields; the magnetic and electric fields, as well as the magnetotelluric impedance across a conducting wedge with an insulating base; the problem of masking in the case of inclined structures; and magnetotelluric formulas for electrically inhomogeneous media; (2) methods of utilizing measurements of tellurics and magnetotellurics in homogeneous

media; (3) magnetotelluric investigations on models; (4) special problems of tellurics and magnetotellurics—influence of the sea on the distribution of the telluric field from the formulas of static potential theory, the constancy of the preferred telluric direction, and the importance of harmonic analysis of magnetotelluric measurement; and (5) magnetotelluric measuring apparatus. R.T.K.

N64-19957* Georgia Inst. of Tech., Atlanta
THEORETICAL AND LABORATORY EXPERIMENTAL RESEARCH IN CHEMICAL RELEASES AT HIGH ALTITUDES Semi-Annual Status Report No. 3, 1 Sep. 1963-29 Feb. 1964
Howard D. Edwards [1964] 3 p refs
(NASA Grant NsG-304-63)
(NASA CR-53933)

The mathematical equations and computer programs developed during the previous period have been improved and extended to other aspects of atmospheric motion. Reduction and analysis of data from the chemical releases in the upper atmosphere that took place in 1962 and 1963 are progressing. The phenomena of diffusion and turbulence in the region above 90 km are being studied. R.T.K.

N64-19960* Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
VISCOUS INTERACTION BETWEEN THE SOLAR WIND AND THE EARTH'S MAGNETOSPHERE
W. I. Axford Repr. from Planet. Space Sci., v. 12, 1964 p 45–53 refs In ENGLISH; RUSSIAN Summary Previously Published as NASA CR-55341; See N64-14287 06-28
(NASA Grant NsG-382)

Order-of-magnitude calculations are used to show that viscous interaction between the solar wind and the earth's magnetosphere can satisfy the energy requirements of a typical magnetic storm. The viscous interaction is considered to be due mainly to turbulence of a compressible nature in the solar wind, and it is shown that this can provide the necessary drag forces, although other mechanisms are not excluded. IAA

N64-19964 Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
AN APPROXIMATE METHOD FOR COMPUTING DIFFRACTION PATTERNS CAUSED BY IONOSPHERIC IRREGULARITIES
Ralph J. Gagnon Aug. 1963 30 p refs
(D1-82-0334)

A method, suitable for investigation of ionospheric phenomena, is derived for computing the amplitude and phase characteristics of an electromagnetic wave after it has been perturbed by a phase distorting screen. Kirchhoff's integral for diffraction is used to evaluate the Fresnel zone fields in terms of a field distribution that is assumed to exist over a plane surface just inside the screen. The perturbing screen is assumed to distort the front of constant phase in one dimension only. By approximating the actual curved wave front with plane wave segments, and with the use of the approximations normally used in diffraction pattern analysis, the fields are evaluated in terms of a sum involving the Fresnel sine and cosine integrals. Several examples are given. Author

N64-19976 DECO Electronics, Inc., Boulder, Colo.
ELF AND VLF ATMOSPHERIC NOISE
E. L. Maxwell and D. L. Stone 10 Jan. 1964 60 p refs
(Contract Nonr-3387(00))
(Rept. 30-P-6; AD-428273)

Atmospheric noise measurements at frequencies from 20 to 50,000 c/s were obtained. The measurements were taken during winter, spring, and summer at latitudes from 71° N to 55° S and near the South American and African storm centers to obtain seasonal and geographical variations. Amplitude probability distributions were used to describe statistical characteristics of the noise and to obtain average to rms conversion factors. The conversion factors were used to convert the E_{avg} data obtained in the field to E_{rms}. These were then normalized and presented as noise densities. Standard deviations of the 5-minute averages were obtained to further describe the statistical characteristics of the noise. The data show a strong correlation with propagation attenuation factors at all frequencies. A good comparison was also obtained with thunderstorm frequency and location predictions. Author

N64-19992* Michigan U., Ann Arbor High Altitude Engineering Lab.
ADDITIONAL ROCKET-BORNE MASS SPECTROMETER MEASUREMENTS OF THE DISSOCIATION OF OXYGEN Scientific Report
E. J. Schaefer and J. Brown Jan. 1964 5 p refs Submitted for Publication
(NASA Contract NASr-54(05))
(NASA CR-53629; Rept. 05627-1-S) OTS: $1.10 ph

An experiment is discussed to measure the ambient neutral composition of the upper atmosphere by a rocket-borne "massenfilter". The major spectral peaks obtained at atomic mass numbers 14, 16, 18, 28, 32, 40, and 44 were identified as N_1, O_1, H_2O, N_2, O_2, A, and CO_2 (and N_2O). In addition, several minor spectral peaks were found on the records. A curve of the ratio of the O_1 current to the O_2 current is presented and compared with a curve obtained in a previous flight. P.V.E.

N64-19994* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME IMPLICATIONS OF A DIRECT MEASUREMENT OF THE HYDROGEN AND HELIUM ION DISTRIBUTION IN THE UPPER ATMOSPHERE
S. J. Bauer Repr. from J. Geophys. Res., v. 69, no. 3, 1 Feb. 1964 p 553–555 refs
(NASA RP-168)

This report is an evaluation of results obtained from measurements of ion composition in the altitude region from 300 to 940 km. The conclusions, if supported by future measurements, may seriously impede efforts to explain charged particle profiles in terms of a ternary ion-mixture model in diffusive equilibrium. It is also evident that even measurements of relative ion abundances can provide useful information on the physical processes in the upper atmosphere. In particular, they can be used to determine ion temperature. IAA

N64-19998 Aerospace Corp., El Segundo, Calif. Space Physics Lab.
SPACE PHYSICS PROGRAM Semiannual Technical Note, 1 Jan.-30 Jun. 1963
R. A. Becker 15 Nov. 1963 30 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-313; TDR-169(3260-01)TN-2; AD-428095)

A scanning monochromator system to measure the earth's albedo in the wavelength interval from 1,600 to 3,100A has been developed to the final design stage. Spectrometers flown on Air Force low-orbiting satellites have provided data on the fluxes, energy distributions, and lifetimes of Soviet-injected electrons; another study concerning the radiation belts dealt

with the role of very-low-frequency waves in precipitating fast electrons. Optical radiation measurements have been made of the vertical distribution of ozone and the radiance of the atmosphere in the ultraviolet. Also during the reporting period, data on a satellite experiment to measure the infrared background radiations of the earth were analyzed. Author

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-19371* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

A LIGHTWEIGHT INSULATION SYSTEM FOR LIQUID

Porter J. Perkins, Jr., and Jack B. Esgar *In* AIAA 5th Ann. Structure and Mater. Conf. 1964 p 361–371 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

A new insulation system consisting of low-density polyurethane foam that is covered and hermetically sealed with a thin-film laminate of Mylar and aluminum foil is investigated. Panels of this construction are bonded and sealed to the outside walls of the tank. Structural rigidity of the insulation panels is achieved by constricting the panels to the tank with a prestressed warp of fiberglass yarn. Conclusions reached as a result of the investigation include the following: (1) It is feasible to use a hermetically sealed fiberglass-wrapped insulation system that weighs only 0.16 lb/sq ft installed on a cylindrical tank. (2) The average thermal conductivity of the insulation system installed on a full-scale Centaur tank was found to be 0.11 (Btu)(in.)/(hr)(sq ft)(°F) at a mean temperature of 215° R during ground-hold tests. (3) A three-ply laminate of Mylar and aluminum with a total thickness of 0.0015 in. was found to provide a good seal against cryopumping air into the insulation during ground hold. P.V.E.

N64-19390 Technion Research and Development Foundation Ltd., Haifa (Israel)

MEASUREMENT OF LAMINAR HEAT TRANSFER RATES OVER A TWO DIMENSIONAL BACKWARD FACING STEP IN A SHOCK TUBE Technical Note No. 3

J. Rom and A. Seginer Feb. 1963 33p refs
(Contract AF 61(052)-576)
(TAE-25; AD-429811)

Heat-transfer rates are measured over a two-dimensional backward facing step in a laminar supersonic flow in the shock tube. The shock Mach numbers range between 4 and 10, the corresponding flow Mach numbers are approximately 1.5 to 2.5, and the Reynolds numbers per cm range between 2×10^3 to 2×10^5. High heat-transfer rates are measured in the reattachment zone. The heat-transfer rate there is found to increase rapidly with increasing Reynolds numbers. The total heat-transfer rate to the separated region is greater than that for the attached flat-plate laminar case for Re_L greater than 2×10^4. The time for establishment of steady flow in the separated flow region is found to depend on shock Mach number. Author

N64-19574* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CYLINDRICAL SECTIONS WITH UNIFORM DIFFUSE-RADIATION CHARACTERISTICS

Max A. Heaslet and Franklyn B. Fuller Repr. from Intern. J. Heat Mass Transfer, v. 6, 1963 p 1049–1052 refs

Calculations are made that determine the cross-sectional shapes of cylindrical or two-dimensional cavities that exhibit uniform radiation characteristics when the interior surface is a diffuse emitter. Immediate applications arise for concave cylindrical radiators or grooves on the surface of an opaque material when temperature is held fixed and uniform emission or heat flux is desired. Geometric interrelations between these and similar results for axially symmetric concavities are determined. Author

N64-19609* Avco-Everett Research Lab., Everett, Mass.

COMPREHENSIVE REPORT ON STUDIES OF HIGH SPEED THERMAL RADIATION AND CONVECTIVE HEAT TRANSFER Final Report

A. Textoris et al Sep. 1963 42 p refs
(NASA Contract NAS9-858)
(NASA CR-53665) OTS: $4.60 ph

The following topics are discussed: (1) high-speed radiation data; (2) N continuum radiation; (3) the generation of meaningful radiation tables; (4) scanning monochromator; (5) radiation from $CO_2 + N_2$ mixtures, (6) convective heat transfer; (7) nonequilibrium and equilibrium radiation at super satellite-reentry velocities; (8) Kramers' and line radiation from nitrogen and air shocks; and (9) the spectrum of shock-heated gases that simulate the Venus atmosphere. R.T.K.

N64-19724* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

INITIATION OF COOLING DUE TO BUBBLE GROWTH ON A HEATING SURFACE

Robert C. Hendricks and Robert R. Sharp Washington, NASA, Apr. 1964 21 p refs Presented at Am. Inst. of Chem. Engr. Meeting, Los Angeles, 4–7 Feb. 1962
(NASA TN D-2290) OTS: $0.50

The surface temperature profile of a nickel–chrome-alloy heater strip during nucleate boiling was matched to high-speed photographic data. The initiation of surface cooling due to bubble growth was investigated and was discussed in relation to existing models of nucleate boiling. Experimental data indicate that, at moderate subcooling, evaporation from a surface liquid film accounts for most of the ebullient heat transfer. No increase in heat transfer due to microconvection or surface quenching by cold bulk liquid was observed. Author

N64-19732 Michigan U., Ann Arbor Coll. of Eng.

INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER Third Quarterly Progress Report, 15 Nov. 1963–15 Feb. 1964

Richard E. Balzhiser, Robert E. Barry, Bruce F. Caswell, Herman Merte, Jr., Andrew Padilla, Jr. et al Wright-Patterson AFB, Ohio, Flight Accessories Lab., Feb. 1964 35 p refs
(Contract AF 33(657)-11548)
(Rept. 05750-9-P; AD-431023)

Burnout data were obtained for water and sodium in the same equipment used previously for potassium studies. These data confirm Addom's water data and Noyes' sodium data. Recent film boiling data obtained by condensing sodium on the bottom side of a horizontal disk on top of which potassium is boiled have yielded inconclusive results. Stable film boiling occurred with the pressure in the potassium chamber less than

1 in. of mercury. Upon increasing the power to the sodium, instabilities were observed causing the system to oscillate as if it were in the transition regime. An analysis of the two-phase pressure drop data has revealed departures from the Martinelli–Nelson or Lockhart type of correlation. Similar deviations have been observed with other data for metallic fluids. A friction-factor correlation is proposed, which correlates data for metallic systems. Author

N64-19761 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT CONDUCTION IN A TWO-LAYER SYSTEM
S. M. Kotlyar 9 Jan. 1964 7 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Belorusskoi SSR (Minsk), v. 6, no. 8, 1963 p 37–40
(FTD-TT-63-1135/1; AD-433536)

An analytical study was made of a stationary temperature field in a two-layer system. The solution of the problem is based on setting it up in the form of equations in pairs permitting precise solution in quadratures through an auxiliary function satisfying Fredholm's equation of the second kind. Author

N64-19817 Kentucky U., Lexington Wenner-Gren Aeronautical Research Lab.
A THEORETICAL STUDY OF SPACE EQUIVALENT THERMAL CONDITIONS AND THEIR APPLICABILITY Technical Documentary Report, May 1963–Jan. 1964
T. A. Auxier Wright-Patterson AFB, Ohio, AMRL, Mar. 1964 115 p refs
(Contract AF 33(657)-11346)
(AMRL-TDR-64-20; AD-437575) OTS: $2.50

Radiation heat-transfer calculations are made for a cylindrical model of a 50th percentile "suited" spaceman in 7 space configurations: (1) deep space probe, (2) a point 136 miles from the bright side of the moon, (3) a point 136 miles from the surface of the dark side of the moon, (4) a point 500 miles from the surface of the bright side of the earth, (5) a point 500 miles from the surface of the dark side of the earth, (6) a 500-mile circular earth orbit, and (7) a 136-mile circular moon orbit. Similarly, radiation heat-transfer calculations are made for the same spaceman model in four hypothetical chamber configurations I, II, III, and IV. The space results are superimposed on the chamber results in order to determine equivalent temperatures for simulating the given space conditions. Author

N64-19977 Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
AN EXACT METHOD OF CALCULATING HEAT CAPACITIES AT HIGH TEMPERATURES AND APPLICATIONS IN GASDYNAMICAL RELATIONSHIPS Technical Note
Benno Walter and Hans Walter Feb. 1964 39 p refs
(R-83)

Fundamental gasdynamical relationships at high temperatures are developed. The relationships differ from the classical formulations in that the heat capacities and their ratios are no longer constant, but depend on the temperature. The presented methods are of specific applicability in propulsion by high-energy propellants as well as by nuclear heated hydrogen. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-19670 Air Force Systems Command, Bedford, Mass. Electronic Systems Div.
SHORT-TERM MEMORY: NON-EQUIVALENCE OF QUERY AND MESSAGE ITEMS
James D. Baker and Walter E. Organist Feb. 1964 24 p refs
(Contract AF 19(604)-5958)
(ESD-TDR-64-254; AD-437917)

This study was designed to discover whether query and message items are equivalent in their effect on short-term memory in situations where a person is required to process a sequence of messages while concurrently processing queries about them. It was assumed that recall is consistently degraded as the number of items interpolated between a message and its subsequent query increases. The results showed that interpolated queries degrade recall significantly more than do messages. Author

N64-19815 Illinois U., Urbana
A TAXONOMY OF LEARNING TASK CHARACTERISTICS Technical Documentary Report, Sep. 1958–Jun. 1962
Lawrence M. Stolurow Wright-Patterson AFB, Ohio, AMRL, Jan. 1964 213 p refs
(Contract AF 33(616)-5965)
(AMRL-TDR-64-2; AD-433199)

Efficient training requires selective use of research findings from basic studies of learning. Decisions about the use of particular principles of learning are constantly required in the development of new training materials, systems, devices, and aids. Consequently, there is a critical need for a system of classifying learning tasks to permit training specialists to make efficient use of principles of learning. This report is designed to assist a training specialist in the design and development of effective training programs for USAF. A system for classifying learning tasks is presented. The research and analytical procedures are summarized along with the findings produced by experimenting with the system. Author

N64-19909 California U., Los Angeles Biotechnology Lab.
HUMAN TRACKING. SENSORY MOTOR CONTROL. MYOELECTRIC CONTROL STUDIES Progress Report
John Lyman 15 Sep. 1963 39 p
(Contract N123(60530)23558A; Grant OVR-RD-1201M)
(Eng. Dept. Rept. 63-57; AD-428192)

The following are discussed: (1) research on the performance of human operators of tracking systems—performance evaluation of variables of the optical system on the Naval Ordnance Test Station tracking simulator and multiman tracking studies; (2) research on sensory motor control—research on arm prostheses sensory motor control problems and analyses of prosthesis–amputee systems; and (3) myoelectric control studies—research on patterns of myoelectric activity during selected arm and truck motions. R.T.K.

N64-19922 Advisory Group for Aeronautical Research and Development, Paris (France)
MEDICAL INDOCTRINATION FOR FLYERS. AN AEROMEDICAL HANDBOOK FOR AIRCREWS
1963 118 p
(AGARD-411, Amend.)

Medical indoctrination is given to aircrews by discussing physiological and psychological facts pertaining to the human body during flight. Among the subjects covered are vision, atmospheric characteristics, decompression sickness, altitude effects on sinuses, hypoxia, noise, g-effects, and other useful

aeromedical information. The material is based entirely on a Royal Canadian Air Force pamphlet entitled "Fit to Fly." (No. 69). G.D.B.

N64-19955* Massachusetts Inst. of Tech., Cambridge Engineering Projects Lab.
FUNCTIONAL EXTENSION OF THE HUMAN HANDS Progress Report, 1 Apr. 1963-30 Sep. 1963
Thomas B. Sheridan 10 Jan. 1964 7 p refs
(NASA Grant NsG-107-61)
(NASA CR-53879; SA-8649-4) OTS: $1.10 ph

Two experiments were performed in an application of the statistical theory of nonlinear control systems developed by N. Wiener and Y. W. Lee to characterize the human operator in a simple tracking loop. Results of the first experiment—an example of the inherent nonlinearities of the closed-loop human operated system—indicated that low order nonlinearities do not account for any substantial part of the linear remnant. The second experiment examined the ability of the operator, placed in a loop with a nonlinear process, to adapt to it. With the given inputs, however, minimum mean-squared-error would be achieved by a linear system; therefore, assuming the operator adapted a mean-square-error criterion, it would appear that he should adopt the inverse of the nonlinear process. Results showed some tendency to compensate for nonlinearity, but were not sufficiently definitive to infer the degree of inverseness of the operator's characteristics. A.W.

N64-19965 Federation of American Societies for Experimental Biology, Washington, D.C.
A STUDY OF THE BIOMEDICAL PROBLEMS RELATED TO THE REQUIREMENTS OF TROOPS AT TERRESTRIAL ALTITUDES OF 10,000 FEET OR ABOVE
Wendell H. Griffith et al 15 Oct. 1963 26 p
(Contract DA-49-092-ARO-9)
(AD-428100)

These committee reports discuss the following: (1) a definition of the problem; (2) factors related to the impairment of performance at high elevations; (3) factors related to the improvement of performance at high elevations by prior conditioning at sea level and at moderate elevations; (4) factors related to the improvement of performance at high elevations by preselection of altitude-tolerant individuals; (5) solution of the problem of impairment of performance at high elevations; (6) conclusions; and (7) recommendations. A.W.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-19298 Ling-Temco-Vought, Inc., Dallas, Tex. Research Center
A SENSITIVE MAGNETIC BALANCE FOR THE DIRECT MEASUREMENT OF SKIN FRICTION DRAG
J. G. Spangler Dec. 1963 35 p refs
(NASA Contract NASw-730)
(Rept. 0-71000/3R-29)

A sensitive balance for making direct measurements of skin friction drag forces in a boundary-layer channel has been built and calibrated. The balance is a null-type instrument employing a crossed current and magnetic field to obtain a restoring force that balances the drag force. The text of this report covers in detail the development and testing of a prototype model balance and the final design, calibration, and performance of the operational skin friction balance. Experimental data are presented to illustrate the quality of measurements that can be made with this instrument. Author

N64-19406 Army Signal Research and Development Lab., Fort Monmouth, N.J.
METEOROLOGICAL APPLICATIONS OF INFRARED RADIOMETRY
Andrew C. Combs Jul. 1963 25 p refs
(USAELRDL-TR-2373; AD-425911)

Portable Infrared Radiation Thermometer, model 14-310, provides more accurate surface temperature measurements and cloud temperature measurements (±1° C) than the R-4D1 Industrial Radiometer. The use of a standard radiation source, such as melting crushed ice, while in flight makes it possible to correct for any effects of ambient temperature on the 14-310 sensing head and amplifier. Results obtained using the R-4D1 radiometer provide a basis for pursuing the development of a radiometer for free-air temperature measurement in the 15 μ (carbon dioxide) spectral region. Author

N64-19590* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PULSE HEIGHT ANALYZER AND COMMUTATING CIRCUITS FOR IMP E vs dE/dx NUCLEAR ABUNDANCE EXPERIMENT
S. Paull, C. Cancro, P. Janniche, and N. Garrahan 4 Oct. 1963 30 p
(NASA TM X-51623; X-631-63-252) OTS: $2.60 ph

The E vs dE/dx experiment for the IMP spacecraft (S-74) is comprised of four cards containing instrumentation and electronics. A cosmic-ray scintillation telescope on one card furnishes analog information on three output channels. Pulse-height analyzer and coincidence logic circuits on two electronics cards change the analog information to digital form, according to certain coincidence logic. A Geiger counter cosmic-ray telescope on the fourth card furnishes digital information to commutating circuits on one of the electronics cards, and from this card outputs from the pulse-height analyzer and commutating circuits are fed to the IMP spacecraft telemetry system. This report describes the pulse-height analyzer, and coincidence logic and commutating circuits. A.W.

N64-19617* New Hampshire U., Durham
DEVELOPMENT OF INSTRUMENTATION TO SEARCH FOR NEUTRONS AND GAMMA RAYS FROM SOLAR SURFACE NUCLEAR REACTIONS Quarterly Status Report, 15 Jan.-15 Apr. 1964
E. L. Chupp 17 Apr. 1964 11 p refs
(NASA Contract NASr-211)
(NASA CR-53828) OTS: $1.60 ph

Research activities reported include: (1) initial work on the fabrication of a directional neutron detector for the energy range 10–30 Mev; and (2) construction of a prototype omnidirectional gamma-ray detector for the 1–3 Mev energy range. R.T.K.

N64-19624* Houston U., Tex.
IMPROVED IONIZATION CROSS-SECTION DETECTORS
J. E. Lovelock, G. R. Shoemake, and A. Zlatkis [1963] 33 p refs Submitted for Publication
(NASA Grant NsG-199-62)
(NASA CR-53635) OTS: $3.60 ph

The ionization cross-section detector is recognized as one of the few unequivocal detection devices available for use in gas chromatography. An integral-pair ionization cross-section detector makes it possible to utilize the desirable characteristics associated with this detection method, at reduced pressures, for programed temperature and pressure (or flow programed operation) without the accompanying deficiencies often encountered with other detection systems. A micro-cross-section detector has been developed with a total volume of 8 microliters. This cell is used to provide cross-section responses for components emerging from 0.01-in.-diam capillary chromatographic columns, thus extending the range of application of ionization cross section. Author

N64-19640 Northeastern U., Boston, Mass.
DESIGN, CONSTRUCTION AND TESTING OF INSTRUMENTATION FOR THE INVESTIGATION OF THE ELECTRICAL STRUCTURE OF THE UPPER ATMOSPHERE Final Report
Louis J. Nardone and Robert D. Stuart 31 Dec. 1963 17 p
(Contract AF 19(604)-7225)
(AFCRL-64-50; AD-436588)

In support of the upper atmosphere, research was conducted on the design, construction, and testing of instrumentation for the investigation of the electrical structure of the upper atmosphere. A description is given of a spherical sensor suitable for use on rockets and satellites to measure the positive and negative charged-particle densities. Complications arising because of the charge on the vehicle and corrective measures are described. A description is also given of the data-reduction procedures employed. Typical results from some of the flights are given. Author

N64-19656 Aeroflex Labs., Inc., Long Island City, N.Y.
FLIGHT EVALUATION OF THE OLD DELFT IMAGE AMPLIFIER CAMERA FOR NIGHT AERIAL RECONNAISSANCE
Richard P. Van Steenburgh Wright-Patterson AFB, Ohio, Res. and Tech. Div., Mar. 1964 55 p
(Contract AF 33(600)-38437)
(RTD-TDR-63-4079; AD-437896)

A two-stage image-amplifier system employing electrostatic focus and a 35-mm camera was evaluated for aerial reconnaissance photography under night ambient light in the aircraft. Photographic density, tone reproduction, brightness gain, and resolution were evaluated under various low light conditions, from starlight through bright moonlight, over a variety of terrain features and targets. The camera was capable of producing negatives of normal density with 1/100-sec exposures when the terrain was illuminated by dim moonlight, and of usable density with 1/2-sec exposures under starlight conditions, using a fast panchromatic film such as Ansco Super Hypan. Image motion compensation and a stabilized camera mount are essential during the relatively long exposures. Author

N64-19765 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TRANSISTOR MEASURING DEVICE, TYPE P-513 [TRANSISTOREN-MESSGERAT, TYP P-513]
6 Feb. 1964 5 p Transl. into ENGLISH
(FTD-TT-63-1211/1; AD-433482)

The transistor measuring device Type P-513 is used for the measurement of zero current, impedance during short-circuited output, short-circuit factor of the current amplifier, and output conductance during open-circuited input of low-capacity transistors of the p-n-p and n-p-n type when in a circuit with a common emitter. Type P-513 consists of an HF amplifier with indicator, a voltage test unit, polarization voltage emitters, and a supply unit. The device weighs 10 kg, and its dimensions are 300 × 200 × 200 mm. It is considered trouble-free and, therefore, valuable in the sorting of a large group of transistors. A.W.

N64-19766 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MEASURING DEVICE, TYPE MPTW-4, FOR TRANSISTORS AND DIODES
18 Feb. 1964 4 p Transl. into ENGLISH from the publ. "Transistoren- und Dioden-Messgerat Typ MPTW-4" Warsaw, Polish Acad. of Sci. 4 p
(FTD-TT-63-1212/1; AD-433539)

The transistor and diode measuring device MPTW-4 is used for measuring the parameters 1-alpha, h_{11}, h_{22}, and h_{12} of low-capacity junction transistors, which are in a common base-circuit of the type p-n-p and n-p-n. The phase balance, which is applied in the device, also allows for the computation of the reactance components of the h-parameters. In addition, the device can be used for the measurement of the capacity change of parametric diodes as a function of the feedback voltage, and for the measurement of the reaction impedance and conductivity of these diodes. Further, the device is applied for the measurement of the impedance, the conductivity, as well as the capacity of photodiodes, and can be used for the measurement of electrical values, i.e., of impedance and capacity. The parameters measured with the aid of this device allow for the effortless and rapid planning of semiconductor circuits. Author

N64-19856 Motorola Inc., Scottsdale, Ariz. Military Electronics Div.
EXTENSION OF ELECTRONIC EQUIPMENT LIFE PREDICTION STUDY Final Report, 1 Apr.-30 Sep. 1963
A. T. Kneale, M. Esher, and G. D. Hase 31 Jan. 1964 72 p
(Contract DA-36-039-SC-87235)
(WP-2643-7; AD-429249)

The aim of this program is to prove the feasibility of providing field instrumentation capable of measuring the rate of degradation of performance in individual electronic devices. The major work accomplished was as follows: (1) selection of the type of equipment to be analyzed and instrumentation for the tests to be performed; (2) analysis of the instrumentation selected for performing the measurement required; (3) analysis of the mathematical approach to be utilized; (4) correlation of computer output with equipment performance; and (5) analysis of the different approaches used for accuracy of prediction. Author

N64-19899* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
THE X-15 FLIGHT TEST INSTRUMENTATION
Kenneth C. Sanderson 21 Apr. 1964 34 p Presented at the 3rd Intern. Flight Test Instrumentation Symp., Buckinghamshire, England, 13-16 Apr. 1964
(NASA TM X-56000) OTS: $3.60 ph

Basic instrumentation requirements for the X-15 airplane were divided into two groups—airborne and ground. Airborne instrumentation consisted of surface-temperature and pressure-measuring equipment, concentrated in the right wing, the nose

area, and the upper vertical tail, and relied on oscillographs and NASA-developed electromechanical self-recording instruments. To provide a source of velocity and altitude data, an integrated inertial-flight-data system (IFDS) was developed. Skin thermocouples were used to secure aerodynamic-heating measurements. Ground instrumentation included three stations using radar, a standard 18-channel FM-FM, and a pulse-duration-modulation system, with reliable reception insured by a servo-driven cross-dipole tracking antenna. Data were recorded on magnetic tape. Voice communication was established by means of standard military UHF ground equipment. The analog flight simulator was valuable in preflight testing of the instrumentation. A.W.

N64-19900 Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
VELA SIERRA VT/4060/ASD(59) First Quarterly Report, 1 Aug.-30 Oct. 1963
Lawrence B. Woolaver 24 Jan. 1964 53 p
(Contract AF 33(657)-12291)
(B-2711; AD-429149)

The design, fabrication, development, testing, and evaluation of a partial preprototype, direct view, optical detection system were studied. Equipment for testing photomultiplier tubes was designed, fabricated, and tested. Methods for measuring sensitivity capacitance, noise performance, and d.c. operating characteristics of photovoltaic cells were devised, and the appropriate equipment was fabricated. Measurements were made of sensitivity, capacitance, and d.c. operating characteristics of three typical photovoltaic cells, and the results are tabulated. C.L.W.

N64-19902* Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
APPLIED RESEARCH ON ELECTRO-MAGNETO-STRICTIVE VIBRAGYRO Final Report, Jan. 8, 1963-Mar. 7, 1964
G. R. Douglas, G. Mott, D. D. Skinner, and J. H. Thompson 1 Apr. 1964 25 p
(NASA Contract NASw-580)
(NASA CR-53882; Res. Rept. 64-969-570-R1) OTS: $2.60 ph

A 1-year program was undertaken to improve the signal-to-noise ratio in the Vibragyro and to identify and reduce the crosstalk components present in the signal output. The Q of both vibratory modes was increased by a factor of 3 or better thus raising the signal strength by a factor of 9. The threshold response to changes in angular rate was determined to be lower than 20° per hour. The optimum magnetostrictive material for this purpose was selected. Author

N64-19974 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
ELECTRO-OPTICAL ATTITUDE MEASURING SYSTEM – A DESIGN STUDY
Bedford, Mass., Electron. Systems Div., Oct. 1963 191 p refs
(Contract AF 19(628)-2900)
(ESD-TDR-63-624; AD-428002)

A design study is documented to investigate a method of electro-optically determining the attitude of a missile from lift-off to 50,000 ft. The attitude in terms of pitch, yaw, and roll is obtained from a single station by lasers illuminating two missile-borne retroreflector packages. Each retroreflector package has as one of its components a Savart plate. The reflected radiation is returned to the receivers where the beams are separated and analyzed by a polarization sensitive system to determine polarization states induced at the Savart plates as the missile's attitude changes. Author

N64-19983* Iowa State U., Iowa City
SATELLITE INSTRUMENTS USING SOLID STATE DETECTORS
R. Walker Fillius (M.S. Thesis) Aug. 1963 131 p refs
(NASA Contract NAS5-1683; NASA Contract NAS5-2054)
(NASA CR-53510; SUI-63-26) OTS: $10.50 ph

Solid-state detectors are described that were used as proton counters in the earth's radiation belts. In a design for low energy protons, a single detector performed pulse-height analysis to classify energies down to 1/2 Mev. Electrons were eliminated by a combination of thin detector, high discrimination levels, and fast-clipping pulse amplifier. A two-element telescope counted higher energy protons and classified them in energy ranges from 18 to 60 Mev. The characteristics of solid-state detectors and their requisite electronics are discussed, along with the design and calibration of the satellite instruments. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-19311* Kansas U., Lawrence
FERREDOXIN OF CLOSTRIDIUM THERMOSACCHAROLYTICUM
Martin Wilder, R. C. Valentine, and J. M. Akagi (Rockefeller Inst.) Repr. from J. Bacteriol., v. 86, no. 4, Oct. 1963 p 861-865 refs
(NASA Grant NsG-298-62; PHS Grant E-4672)

The isolation of ferredoxin from the thermophilic anaerobe *C. thermosaccharolyticum* was investigated. By utilizing the phosphoroclastic and the hydrogenase systems of this organism, it was found that the ferredoxin that was isolated was similar to those already mentioned in the literature. The present experiments with the hydrogenase of *C. thermosaccharolyticum* support the view that the enzyme functions in close proximity with ferredoxin in the formation of molecular hydrogen. R.T.K.

N64-19313* Cedars of Lebanon Hospital, Los Angeles, Calif. Inst. for Medical Research
A TECHNIQUE FOR TESTING HEART FUNCTION BY ANALYSIS OF ITS VIBRATION SPECTRUM
Clarence M. Agress and Palmer R. Mc Innis (Telecomputing Services, Inc.) 21 Feb. 1964 141 p refs
(NASA Grant NsG-289-62)
(NASA CR-53813) OTS: $11.00 ph

Investigations cover: (1) the physical principles and physiology underlying the transfer of cardiac vibrational energy to the chest wall; (2) the development of instrumentation and techniques required for heart-vibration-data recording; (3) the interpretation of cardiac vibrational energy; and (4) the development and implementation of semiautomatic methods for the measurement and computation of heart-function data. It was found that the vibrational waves recorded from the chest wall showed a high degree of correlation with hemodynamic events. It was shown that measurement of the phases of isometric contraction, ejection, systole, and diastole could be obtained from the precordial vibration tracing with an accuracy as good

as that realized with direct cardiac catheterization. Further, comparisons of these phase intervals, under stress procedures, in human and animal subjects showed significant changes that served to differentiate the normal from the cardiac-injured subject. These changes correlated well with other physiologic parameters during maximum stress. R.L.K.

N64-19393 Naval Research Lab., Washington, D.C. Chemistry Div.

SUBMARINE ATMOSPHERE STUDIES ABOARD USS SCULPIN

M. E. Umstead, W. D. Smith, and J. E. Johnson 27 Feb. 1964 27 p refs

(NRL-6074; AD-433896)

Studies of the organic contaminants in the atmosphere of U.S.S. Sculpin were made during a submerged cruise. Detailed analyses were made of the concentrations of methane, Freon-12, and total hydrocarbons by means of a backflush gas chromatograph of new design. The effectiveness of the CO/H_2 burners and main carbon bed as removal agents for organic contaminants was included in the studies. The CO/H_2 burners satisfactorily burned organic contaminants at temperatures as low as 500° F. The active carbon in the main filter bed removed the higher hydrocarbons, but was not effective for removing lower hydrocarbons and Freon-12. Experimental data obtained on shipboard indicated that the rate of generation of organic vapor contaminants was about 1.5 lb daily. Author

N64-19407 Naval Research Lab., Washington, D.C. Chemistry Div.

NUCLEAR SUBMARINE ATMOSPHERE. PART 2 – DEVELOPMENT OF A TOTAL HYDROCARBON ANALYZER

J. E. Johnson, M. E. Umstead, and W. D. Smith 30 Jan. 1964 8 p refs

(NRL-6064; AD-431141)

An instrument was developed for the shipboard monitoring of total hydrocarbons in nuclear submarine atmospheres. In addition to hydrocarbons, the instrument also measures methane and Freon-12 and, with a slight modification in operating procedure, Freon-11. The system is based on a chromatographic technique coupled with a highly sensitive flame-ionization detector. An air sample is injected into a chromatographic column and chromatographed in the usual manner until the methane and Freon-12 peaks emerge. At this point, the flow of carrier gas is reversed and the higher hydrocarbons are backflushed from the column through the detector as a single peak. The area under the backflushed peak provides a measure of the total hydrocarbon content of the atmosphere. The principles on which the instrument is based were successfully tested at sea aboard the U.S.S. Sculpin. Author

N64-19437 Joint Publications Research Service, Washington, D.C.

BIOPHYSICAL STUDIES ON POLYMERS, NUCLEIC ACIDS AND BRAIN NEURONS

21 Apr. 1964 40 p refs Transl. into ENGLISH of 3 articles from Biofizika (Moscow), v. 8, no. 3, 1963 p 288–293, 294–300, 387–393

(JPRS-24261; OTS-64-31105) OTS: $1.00

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1. THE THEORY OF SPIRAL-TO-BALL TRANSITIONS IN BIOPOLYMERS B. A. Fedorov, T. M. Birshteyn, and O. B. Ptitsyn p 1–11 refs (See N64-19438 12-07)

2. OPTICAL PROPERTIES AND MOLECULAR STRUCTURE OF NUCLEIC ACIDS AND THEIR COMPONENTS B. I. Sukhorukov, Yu. Sh. Moshkovskiy, T. M. Birshteyn, and V. N. Lystsov p 12–23 refs (See N64-19439 12-16)

3. APPLICATION OF MATHEMATICAL METHODS FOR INVESTIGATION OF IMPULSE ACTIVITY OF CENTRAL NEURONS OF THE BRAIN N. N. Preobrazhenskiy and N. V. Yarovitskiy p 24–37 refs (See N64-19440 12-16)

N64-19439 Joint Publications Research Service, Washington, D.C.

OPTICAL PROPERTIES AND MOLECULAR STRUCTURE OF NUCLEIC ACIDS AND THEIR COMPONENTS

B. I. Sukhorukov, Yu. Sh. Moshkovskiy, T. M. Birshteyn, and V. N. Lystsov *In its* Biophys. Studies on Polymers, Nucleic Acids, and Brain Neurons 21 Apr. 1964 p 12–23 refs (See N64-19437 12-16) OTS: $1.00

Temperature melting curves of DNA have been investigated in a wide range of pH values in both the acid and the alkaline regions. The T_{mp}-to-pH relationship, which may be explained by ionization processes of nucleotide bases, has been obtained. The phase diagram of the spiral-to-ball transition in relation to T and pH has been constructed. Enthalpy and entropy of the coupling of a pair of nucleotide residues $\Delta H = 10$ to 11 kcal/mole and $\Delta S = 30$ cal/mole · deg have been found on the basis of the T_{mp}-to-pH relationship. Effective enthalpy and effective entropy of the spiral-to-ball transition have been determined, and it was found that in the region of neutral pH the average number of nucleotide pairs breaking simultaneously amounts to ~10 and increases with the transition to the extreme values of pH. Author

N64-19440 Joint Publications Research Service, Washington, D.C.

APPLICATION OF MATHEMATICAL METHODS FOR INVESTIGATION OF IMPULSE ACTIVITY OF CENTRAL NEURONS OF THE BRAIN

N. N. Preobrazhenskiy and N. V. Yarovitskiy *In its* Biophys. Studies on Polymers, Nucleic Acids, and Brain Neurons 21 Apr. 1964 p 24–37 refs (See N64-19437 12-16) OTS: $1.00

An attempt was made to develop a mathematical method for the analysis of the impulse activity of central neurons. Investigation of the activity of the reticular neurons of a cat with chlorazol narcosis served as the material for mathematical analysis. The method that is proposed makes it possible to find the general forms of the cell's responses to action, to find the number of the degrees-of-freedom of the response, and to calculate the values of these parameters. R.T.K.

N64-19465 California U., Berkeley. Lawrence Radiation Lab.

A SEARCH FOR PHOTOINDUCED POLARIZABILITY CHANGES IN PHOTOSYNTHETIC AND MODEL SYSTEMS

Terry Trosper and Kenneth Sauer *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 6–10 refs (See N64-19463 12-01) OTS: $0.75

Possible changes in electronic polarizability alpha at optical frequencies were investigated by following light-scattering changes in a suspension of the sample. A suspension of bacterial chromatophore aggregates was studied. Lead sulfide and cadmium sulfide suspensions were chosen as model systems. In each case, filter systems were selected. The small change observed in the experiment with chromatophore aggregates cannot be considered significant because of lack of adequate controls and repetition. Again, the fraction of excited particles in the suspensions was also too small to cause any noticeable effect. A.W.

N64-19470 California U., Berkeley. Lawrence Radiation Lab.
INHIBITOR STUDIES ON THE CARBON-REDUCTION CYCLE IN CHLORELLA
Edwin S. Gould, J. A. Bassham, and Martha Kirk *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 20–22 refs (See N64-19463 12-01) OTS: $0.75

This study showed that carbonyl cyanide *m*-chlorophenylhydrazone (CCCP) strongly inhibits photophosphorylation but is without effect on triphosphopyridine nucleotide (TPN) reduction in spinach chloroplasts. The 2,4-dichlorophenyl dimethylurea (DCMU), by analogy with the known action of its monochloro analog, blocks the transfer of electrons from water and stops the reduction of $NADP^+$ to NADPH in the absence of added electron donors. A.W.

N64-19471 California U., Berkeley. Lawrence Radiation Lab.
STUDIES ON THE QUINONE COMPOSITION OF CHLORELLA PYRENOIDOSA
Hartmut K. Lichtenthaler *In its* Bio-Organic Chem. Quart. Rept. 20 Jan. 1964 p 23–27 refs (See N64-19463 12-01) OTS: $0.75

Results indicate the presence of five principal quinones, probably two plastoquinones, two unidentified quinones associated with an ergosterol derivative, and a quinone from the vitamin-K type that is not, as in higher plants, vitamin K_1. It is also indicated that 6-hour photosynthesis is sufficient to produce labeled quinones from 14_{CO_2}. A.W.

N64-19491 Joint Publications Research Service, Washington, D.C.
NEW PSYCHOPHARMACOLOGICAL PREPARATIONS
V. V. Zakusovof 5 May 1964 31 p refs Transl. into ENGLISH from Farmakol. i Toksikol. (Moscow), v. 27, no. 1, Jan.–Feb. 1964 p 107–121
(JPRS-24475; OTS-64-31205) OTS: $0.75

New drugs of value in the treatment of psychic disturbances are listed and discussed. These psychopharmacological preparations are divided into: (1) tranquilizers; (2) psychostimulants; (3) psychosomimetics; and (4) antidepressants. Chemical structures of more than 50 such preparations are given and evaluated as to efficacy in specific disorders. A.W.

N64-19495* Maryland U., College Park
ON THE VARIABILITY IN THE ACTIVITY OF THE PHOTOSYNTHETIC MECHANISMS
Constantine Sorokin Repr. from "Photosynthesis Mechanisms In Green Plants," NAS-NRC Publ. 1145, 1963 p 742–750 refs
(NASA Grant NsG-70-60)

The effect of shifts in the age composition in a batch of cells under investigation, and of the changes in the size of the active part of metabolic mechanism in each particular cell (as affected by metabolic turnover) is considered in this annotated bibliography. R.L.K.

N64-19544* Kansas U., Lawrence
MUTATIONAL SYNERGISM BETWEEN RADIATIONS AND METHYLATED PURINES IN ESCHERICHIA COLI
Ira N. Doneson and Delbert M. Shankel Repr. from J. Bacteriol., v. 87, n. 1, Jan. 1964 p 61–67 refs
(NASA Grant NsG-298-62; NSF Grant 18073)

A synergistic mutational effect was demonstrated between low doses of ultraviolet light and the methylated purines caffeine, theophylline, and theobromine. Caffeine produced the greatest effect and theobromine the least effect. The magnitude of the synergism was inversely related to the ultraviolet dosage. A large percentage of the synergistic effect could be "photoprevented" by exposure of the ultraviolet-treated cells to white light prior to exposure to the analogs. The consequence of the combined treatment occurred only when the chemical treatment followed the ultraviolet treatment. Synchronous growth studies indicated that a particular growth stage of the organisms was most susceptible to the synergistic effect. The mutation studied was that of *Escherichia coli* B/r to high-level streptomycin resistance. Author

N64-19556 Northwestern Technological Inst., Evanston, Ill.
GROSS CHEMICAL CHANGES OF HUMAN WASTE UNDERGOING THERMAL DECOMPOSITION
J. E. Quon, W. O. Pipes, and J. A. Logan Fort Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1963 11 p
(Contract AF 41(657)-383)
(Tech. Note 62-13; AD-434081)

Solubility and carbon content of the residue after ignition at 400° C were determined for different rates of air supply to the volatilization chamber. Information on the relationship between residual weight and oxygen supply and between residual carbon and oxygen supply was obtained with the volatilization chamber operated in two stages with respect to temperature, and the carbon content of the ash was determined after each stage. Carbon monoxide and carbon dioxide analyses of the volatilization chamber effluent were made, using an Orsat apparatus. A series of experiments to determine if the solid residue remaining after the volatilization of human wastes contained nutrients adequate for algal growth were undertaken. Samples of the residue and supplemental nutrients were added to distilled water to make up a culture medium for algal growth. The media made up in this manner were dispensed into flasks and inoculated with *Chlorella*. Cell counts were made on the cultures at two different times after inoculation to determine if any growth was occurring. R.L.K.

N64-19557 New Hampshire U., Durham
INTUBATION OF THE ABNORMAL AORTA OF THE ALASKAN GROUND SQUIRREL
J. P. Schmidt and T. G. Metcalf Fort Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1963 5 p refs
(Contract AF 41(657)-350)
(Tech. Note 63-2; AD-434083)

A technique for abdominal aortic intubation of Alaskan ground squirrels is described. A total of 23 squirrels have been intubated without impairment of their normal functions. P.V.E.

N64-19577* Marquardt Corp., Van Nuys, Calif.
STUDY OF MARBAC EXTRATERRESTRIAL LIFE DETECTION CONCEPT Fifth Monthly Letter Report, 1 Mar.–31 Mar. 1964
E. E. Sweeney and G. E. Ellis [1964] 14 p
(NASA Contract NASw-810)
(NASA CR-53734) OTS: $1.60 ph

Bacterial growth, primarily cell division, was studied with relation to oxidation-reduction potential change. Relatively large inocula were used (e.g., 10^7 organisms/milliliter). The rate of change in potential generally correlated with increase in cell numbers; the rate of change of potential reached its maximum at approximately the time the cell growth reached its maximum rate. Correlation among viable counts (plating), Coulter counts, and turbidimetric readings indicated that, with large bacterial concentrations, each method could be useful in redox investigation. Author

N64-19583* California U., Berkeley Space Sciences Lab.
BIOLOGICAL CONTAMINATION OF MARS II. COLD AND ARIDITY AS CONSTRAINTS ON THE SURVIVAL OF TERRESTRIAL MICROORGANISMS IN SIMULATED MARTIAN ENVIRONMENTS
E. Packer, S. Scher, and C. Sagan (Harvard Coll. Obs.) Repr. from Icarus, v. 2, no. 4, Nov. 1963 p 293–316 refs
(NASA Grant NsG-126-61)

Terrestrial microorganisms were collected from a variety of environments, including regions of high alkalinity, low mean daily temperature, and low annual rainfall. The air-dried soils were then subjected in the presence of a dessicant to a simulated Martian environment involving 12-hour freeze-thaw cycles from about −60° C to about +20° C; atmospheres of 95% nitrogen, 5% carbon dioxide, and low moisture content; ≤0.1 atm pressure; and a total ultraviolet dose at 2,537 A of 10^9 erg cm^{-2}. Survivors were scored on supplemented agar. Preliminary results indicate a wide variety of survivors including obligate and facultative anaerobic spore-formers and nonspore-forming facultative anaerobic bacteria. Diurnal freezing and thawing were continued for 6 months. There was no significant loss of viability after the first freeze-thaw cycle. Author

N64-19584* Esso Research and Engineering Co., Linden, N.J.
EVIDENCE IN METEORITES OF FORMER LIFE: THE ORGANIC COMPOUNDS IN CARBONACEOUS CHONDRITES ARE SIMILAR TO THOSE FOUND IN MARINE SEDIMENTS
W. G. Meinschein, Bartholomew Nagy, and Douglas J. Hennessy (Fordham U.) Repr. from Ann. N.Y. Acad. Sci., v. 108, Art. 2, 29 Jun. 1963, p 553–579 refs
(NASA Contract NASw-508)

Aromatic hydrocarbons have been identified as common constituents of meteoritic and terrestrial sedimental extracts. Saturated hydrocarbons isolated from the Murray and Orgueil carbonaceous chondrites have infrared spectra, molecular weight ranges, and cracking patterns in the mass spectrometer that resemble those of sedimental saturated hydrocarbons. The relative amounts of hydrocarbons and nonhydrocarbons, the infrared spectra of the nonhydrocarbons, and the free sulfur contents of the benzene extracts of the Orgueil and terrestrial marine sediments are similar. Except for the relative simplicity of the aromatic fraction from the Orgueil fragment, analyses of both the Orgueil and Murray extracts fall within the range of compositional variations observed in terrestrial sediment extracts of plant and animal hydrocarbons. Author

N64-19768 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BIOLOGICAL RHYTHMS AND ASTRONAUTICS
Yu. Fedotov and Ye. Yudin 3 Mar. 1964 8 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), no. 212, (11817), 8 Sep. 1962 p 6
(FTD-TT-64-26/1; AD-433610)

Biological diurnal periodicity is apparently maintained in space flight, for the flight lengths achieved to date, and in animal experiments that attempted to produce new biological rhythms by changing the environmental rhythm. But changing the biological rhythm is possible, as in the case of tamed wild animals, along with physical and chemical media changes. In order to maintain the astronauts' capacity for work, use is made of light, color, sound, and musical stimulation. R.L.K.

N64-19783 Joint Publications Research Service, Washington, D.C.
EVALUATION OF THE FLEXIBILITY OF DNA MOLECULES BY MEANS OF LIGHT SCATTERING AT LARGE ANGLES
O. B. Ptitsyn and B. A. Fedorov *In its* Study of DNA Mol. Flexibility and Continuous Models of Excitable Media 20 Apr. 1964 p 1–10 refs (See N64-19782 12-01) OTS: $0.75

A method has been suggested for the estimation of the flexibility of semirigid molecules (specifically, the molecules of natural DNA) by light scattering. This method is based on the processing of data at large scattering angles. The method consists of the determination of the line segment cut off by the asymptote of the curve P^{-1} [$\sin(\theta/2)$], the magnitude of which does not depend, in practice, on the model of the chain (worm-shaped or zig-zag-shaped) and is determined by the flexibility of the molecule (by the value of the persistent length). The processing of published experimental data on light scattering of natural DNA molecules by this method leads to the values of the persistent length of 270 ± 50 A that are close to the value of 360 A obtained from the data on sedimentation. Author

N64-19799 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg, W. Germany Inst. für Flugmedizin
THE BEHAVIOR OF EOSINOPHILIC BLOOD CELLS UNDER DIFFERENT TESTS IN THE SAME INDIVIDUAL [DAS VERHALTEN DER EOSINOPHILEN BLUTZELLEN UNTER VERSCHIEDENEN BELASTUNGEN BEI GLEICHEN INDIVIDUEN]
Marlies Tippelmann Porz-Wahn, W. Germany, DVLR Wiss. Berichtswesen, Mar. 1964 73 p refs In GERMAN
(DVL-310)

The nonspecific defense reactions of organisms to oxygen deficiency stress and the question of a correlation between the effect of these reactions on the pituitary–adrenal cortex system are discussed. This effect was measured by the decrease in eosinophile leucocytes. The degree of oxygen deficiency tolerance was determined with the help of the ball test in a low-pressure chamber. Students with an average age of 23 were classified according to classes A and B by routine oxygen deficiency stress tests. Group A had the more rapid drop in efficiency and an early onset of regulatory breakdown. Group B had a better tolerance and an asymptotic efficiency drop. Group A showed a larger decrease in eosinophiles than did group B. Also, group B showed a subsequent rise in the eosinophile count within a predetermined time, whereas group A did not. Apparently, under equal stress, a stonger activation of the pituitary–adrenal cortex system occurred in group A than in group B. It is indicated that the stronger reactions of group A were due to a higher sensitivity to stress, since the pituitary–adrenal cortex system of both groups were functioning equally well. I.v.L.

N64-19822 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Med. Div.
DETERMINATION OF THE SOLUBILITY OF NITROGEN IN WATER AND EXTRACTED HUMAN FAT
Kenneth G. Ikels Feb. 1964 12 p refs
(SAM-TDR-64-1; AD-434426)

A gas chromatographic technique in conjunction with a modified Van Slyke apparatus is described for the determination of the Bunsen absorption coefficient for nitrogen in extracted human and dog fats, olive oil, and water. Essentially, the method consists of a double extraction of a sample that has been equilibrated at a stated temperature with a known gas. The liberated gas or gases are then separated and quantified by gas chromatography. The observed Bunsen absorption coefficient for nitrogen in water agrees closely with one of the two sets available in the International Critical Tables at 37.6° C. The present method may also be regarded as accurate for the nitrogen solubility in fats and oils. Author

N64-19825 Florida State U., Tallahassee Inst. for Space Biosciences
DYNAMIC PHENOMENA IN MICROSPHERES FROM THERMAL PROTEINOID
Sidney W. Fox and Shuhei Yuyama Repr. from Comp. Biochem. Physiol., v. 11, 1964 p 317-321 refs
(NASA Grant NsG-173-62; NIH Grant C-3971)
(*Its* Contrib. 15)

Time lapse photomicrographic evidence is presented for the occurrence in self-organized supramacromolecular units of optical disappearance of interior material to leave outer boundary or membrane; Brownian motion within the unit; appearance of septa that divide the units. These phenomena occur in a suspension of particles formed from thermal polyamino acid. The dynamic phenomena are triggered by an increase in pH with phosphate-citrate buffer. The formed units and the phenomena they display arise from the material formed in an experimental continuum, and thus provide a model for how some precellular phenomena might have arisen spontaneously.
Author

N64-19865 Rochester U., N.Y. Radiation Chemistry and Toxicology Div.
THE DILUTION TEST AS A MEASURE OF RENAL FUNCTION IN NIOBIUM POISONED RATS
William L. Downs and Jonathan H. Harwood III 6 May 1964 21 p refs
(Contract W-7401-ENG-49)
(UR-646)

Control, female, albino rats given a water load of 50 ml/kg, excreted 50 percent of this load as urine within 94 ±11 minutes ($T_{EU_{50}}$). The administration of a single intraperitoneal dose ranging from 10 to 30 mg Nb/kg resulted in 2- to 4-fold increases in the $T_{EU_{50}}$ value 24 hr after the niobium was injected. When niobium was complexed with ascorbic acid prior to injection, the $T_{EU_{50}}$ value was within control limits. However, rats given a single intraperitoneal dose of niobium and then given 3 doses of ascorbic acid at intervals of 1, 3, and 6 hrs showed $T_{EU_{50}}$ values that were not markedly different from those observed in rats given niobium only. Increased $T_{EU_{50}}$ values were observed in rats given single intraperitoneal doses of uranyl nitrate (1.2 to 2.4 mg U/kg), mercuric chloride (2.0 mg Hg/kg), and sodium tripolyphosphate (480 mg/kg). Author

N64-19877 Army Biological Labs., Fort Detrick, Md.
METHODS FOR THE BACTERIOLOGICAL INVESTIGATIONS OF UPPER LAYERS OF THE ATMOSPHERE
Ya. G. Kishko Jun. 1963 7 p refs Transl. into ENGLISH from Lab. Delo (Moscow), v. 5, 1959 p 37-39 Presented at the All-Union Conf., Inst. of Gen. and Communal Hygiene, Moscow, 26 May 1958
(AD-428703)

A device, suitable for collecting air samples from an airplane, that consists of a collector, a cassette, and an airflow meter is discussed. The intake section is located on the outside of the airplane, and air is drawn through, by the movement of the plane, to a culture medium in a Petri dish, seeding it with microorganisms. Up to 0.5 cubic meters is filtered in 3 to 6 minutes. To prevent freezing at high altitudes, a thin layer of sterilized MC-10 oil was used to cover the surface of the culture medium; the number of microorganisms growing under this condition was always higher than when the surface was not so covered.
R.L.K.

N64-19892 General Dynamics/Fort Worth, Tex.
MECHANICAL TECHNIQUES FOR KILLING, REMOVING, OR CONTROLLING MICROORGANISMS IN HYDROCARBON FUELS Technical Documentary Report, 1 Jul. 1962-Aug. 1963
H. P. Owen, M. T. Carroll, H. G. Hedrick, T. W. Albrecht, and D. J. Pritchard Wright-Patterson AFB, Ohio, Aero Propulsion Lab., Dec. 1963 145 p refs
(Contract AF 33(657)-9181)
(ASD-TDR-63-242; AD-428866)

The objective of this program was to examine all known mechanical techniques for killing, removing, or controlling microorganisms found in hydrocarbon fuels. In Phase I, a theoretical analysis of 18 mechanical techniques is presented. The microorganisms included bacteria and fungi that live in water, in a water-fuel interface, and within the hydrocarbon fuel. A group of 20 microorganisms, representative of those found in aircraft fuel tanks and fuel storage tanks, were selected for use in the various experiments. Phase II gives a complete evaluation on using radiofrequency (RF) irradiation and ultrafine mechanical filters. The sterility of treated fuel samples was established, the effect of each technique on the fuel and fuel additive properties determined, and the effect of the treated fuel on fuel tank sealants and O-rings investigated. Design criteria to aid in the eventual development of prototype items were prepared.
Author

N64-19919 System Development Corp., Santa Monica, Calif. Special Development Dept.
METHODS OF THE MANUAL ANALYSIS OF MULTI-SOURCE, CONTINUOUSLY RECORDED BIOMEDICAL DATA
J. Wilson Nance 30 Jun. 1963 75 p refs
(Contract AF 19(628)-1648)
(TM-1210/000/01; AD-428600)

Application is made of electronic digital computers to the screening and analysis of biomedical data, by an examination of the analytic logic employed by the clinical diagnostician. A tremendous advantage can be given to the clinician in providing him with a computer program that will do mass screening operations on continuously recorded data. The data will be taken from physiological measurements of electrocardiograph, ballistocardiograph, phonocardiograph, electroencephalograph, electrooculograph, pneumograph, and galvanic-skin-response instruments.
A.L.B.

N64-19921 Rochester U., N.Y.
A PRELIMINARY STUDY OF BEHAVIORAL EFFECTS IN PIGEONS EXPOSED TO MERCURY VAPOR AT A CONCENTRATION OF 0.1 MG/M^3
R. P. Beliles, R. S. Clark, P. R. Belluscio, C. L. Yuile, and L. J. Leach 27 Apr. 1964 10 p refs
(Contract W-7405-ENG-49)
(UR-ENG-49-7) OTS: $0.50

Three male Carneaux pigeons (1 control, 2 experimental) were trained to a multiple FR-60 FI-15 schedule of reinforcement. After relative behavioral stability was obtained, the experimental animals were exposed 6 hours a day for 20 weeks to mercury vapor at a concentration level of 0.1 mg/m^3. No behavioral, histological, or gross signs of mercurialism were noted.
Author

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see:* 08 Auxiliary Systems.

N64-19307 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
EXPERIMENTAL STUDY OF FACTORS CONTROLLING THE EFFECTIVENESS OF HIGH-TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN Summary Report, 15 May 1962-15 Jun. 1963
C. D. Dickinson and L. L. Seigle Wright-Patterson AFB, Ohio, AF Materials Lab., 15 Jul. 1963 185 p refs
(Contract AF 33(657)-8787)
(ASD-TDR-63-744; TR-63-461.12; AD-435148) OTS: $13.00

The oxidation at elevated temperatures of Zr-Th, Zr-Y, Hf-Y, Hf-W, Hf-W-Re, Al-Cr-Sn, and Al-La-Sn alloys, as well as ZrN, HfN and ZrN–ThN combinations has been studied in order to clarify specific aspects of the problem of protecting tungsten against oxidation at high temperatures. Experimental results showed that there was much less tendency for ZrO_2, ThO_2, and HfO_2 scales to crack during growth at high than at low temperatures. The sequence of layers at the metal–air interface of the Zr-Th and Zr-Y alloys formed by diffusion controlled oxidation was governed by a simple rule; namely, that the diffusion path in the appropriate isothermal section of the ternary equilibrium diagram is a straight line connecting the alloy composition with the oxygen corner. Observations have been made of the rate of formation, nature and morphology of scales formed on the brittle refractory compounds W_2Hf, ZrNi, HfN, and ZrN-ThN, and those formed on liquid Zr-Y, Al-Cr-Sn, and Al-La-Sn alloys. Author

N64-19317 California U., Berkeley. Lawrence Radiation Lab.
REMOTE PIPETTERS FOR USE IN HOT CELL ENCLOSURES
Edward S. Fleischer, A. Boyd Snyder, Thomas C. Parsons, and Patrick W. Howe 11 Mar. 1964 11 p refs
(Contract W-7405-ENG-48)
(UCRL-9661) OTS: $0.50

This system presents a method for remote pipetting that features precision and excellence of control. The operator and pipetter controller are generally separated from the box-enclosed mobile pipetter head by shielding that may be up to several feet in thickness. In the 6-ft Water-Cave Neutron Facility a Kollmorgen periscope is used in conjunction with one pipetter for the taking of samples in the range of 1λ to 10λ. Pipettes can be replaced remotely in the pipetter head by the box manipulators. Pipetter units of capacity 1λ to 1 ml and 1λ to 5 ml, and also macro units up to 30 ml are available. Author

N64-19364* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADAPTATION OF A MoS_2 "IN SITU" PROCESS FOR LUBRICATING SPACECRAFT MECHANICAL COMPONENTS
Charles E. Vest *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 120–125 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

This "in situ" process consists of surface activation treatment—electrodeposition of an MoO_3 complex ion onto the substrate surface, and conversion of this film to MoS_2 in an atmosphere of H_2S gas at 400 psig pressure and 195° C, for an exposure period of 4 to 8 hours. From the work performed and the test results, it is concluded that this process is adaptable to space components. It is also concluded that: (1) the film thickness can be controlled within ±35 μ inches; (2) the average coefficient of friction of this film is 0.05 or less, and is comparable to or the same as MoS_2 powder and lower than bonded MoS_2 films; (3) the film can be easily and safely deposited onto a number of common spacecraft materials; (4) the film has a better wear life than sodium silicate bonded MoS_2, slightly better wear life than a burnished MoS_2 powder, and a somewhat poorer wear life than epoxy bonded MoS_2; and (5) the film follows the surface contour and fills up the smallest crack, lap, seam, or indentation. P.V.E.

N64-19397 Illinois U., Urbana Coordinated Science Lab.
AUTOMATA AND SEQUENTIAL MACHINES, A SURVEY
Herbert Y. Chang Jun. 1963 42 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-168; AD-420855)

A brief study of the application of concepts of automata theory to analysis and synthesis of sequential machines has been made. After defining models of sequential machines, two ways of characterizing a machine, namely, the input–output signal set (or regular expression) method and the computer-program method, are indicated. The discussion on analysis of machines is concentrated on experiment performing, a way to examine a machine's structure by merely applying inputs and observing outputs; and machine decompositions. Some of the results and difficulties related to state reduction and state assignment in machine synthesis procedures are mentioned. Author

N64-19505 Western Electric Co., Inc., Oklahoma City, Okla.
AN APPROACH TO MANUFACTURING DEVELOPMENT
C. J. Stapp *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 14 p refs (See N64-19501 12-01)

An approach is presented for use in deciding whether or not a new process for the manufacture of a given product should be incorporated into the existing manufacturing assembly. The method is based on determining the economical return to be obtained as interest on the initial investment. P.V.E.

N64-19506 Western Electric Co., Inc., Oklahoma City, Okla.
THE APPLICATION OF HEAT SHRINKABLE HYLAR TO RELAY MANUFACTURER
B. J. Groves *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 12 p (See N64-19501 12-01)

New methods for assembling relays were studied. The method chosen was the use of heat-shrinkable Mylar in the relay assembly; this proved most efficient, since all parts would have a function in the finished relay. Mylar is a superior insulator, and its strength is utilized to hold the terminals of the relay in place during assembly. In one of the manufactured relays, greater reliability will result from this improved insulation. Also, a reduction in relay cost is possible through elimination of those parts formerly needed only for assembly purposes. P.V.E.

N64-19508 Guardian Electric Mfg. Co., Chicago, Ill.
A NEW TWIST IN RELAY AUTOMATION
John Schmidt, Jr. *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 17 p (See N64-19501 12-01)

Design and production development of a two-pole double-throw 10-ampere relay for 115 volt, 60 cycle, a.c. operations are described. P.V.E.

N64-19510 Wabash Magnetics, Inc., Ind. Deluxe Coils Div.
MOLDED COILS AND RELAYS
James A. Foerster *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 10 p refs (See N64-19501 12-01)

A project to test epoxy encapsulated coils is described. The theory of thermal fatigue was firmly established. The accelerated aging tests, in which the temperature is increased so that a shorter testing time may be used, will probably be invalidated when the actual life-testing data becomes available. The application of theoretical conclusions to the practical aspects of manufacture is discussed. P.V.E.

N64-19511 General Electric Co., Bloomington, Ill. General Purpose Control Dept.
CIRCUITS FOR TESTING RELIABILITY OF RELAYS
Carl W. Loeseke *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 12 p (See N64-19501 12-01)

A circuit for life testing several relays simultaneously is discussed. The circuit is used to check the following: (1) failure of a contact to conduct, (2) failure of the relay to drop out to the deenergized position, (3) magnets requiring several closures before sealing, (4) contact opening due to magnet vibration, and (5) breakages or wear that affect relay operation. The circuit identifies each failure and correctly assigns the failure to the proper relay. P.V.E.

N64-19512 Allied Control Co., Inc., New York, N.Y.
ACCEPTANCE TESTING FOR RELIABILITY ANALYSIS
John L. Farbo *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 8 p refs (See N64-19501 12-01)

Acceptance tests currently in existence, and those proposed are discussed in terms of (1) setting the relay specifications; (2) reliability numbers; (3) cost of acceptance test program; (4) the acceptance tests (optimum and actual working acceptance test); and (5) acceptance test data analysis. P.V.E.

N64-19517 Picatinny Arsenal, Dover, N.J.
ON STOCKPILE ELECTRICAL RELIABILITY OF SEALED SWITCHING DEVICES FOR NUCLEAR WEAPONS
Paul Mahler *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 10 p (See N64-19501 12-01)

Special requirements that should be included in the general reliability requirements for relays used in special weapons are discussed. A method is presented for production of uncontaminated sealed switching devices costing less than less reliable devices currently manufactured by customary assembly procedures. P.V.E.

N64-19522 Associated Research, Inc., Chicago, Ill.
AUTOMATIC RELAY TESTING
Harold N. Miller *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 13 p (See N64-19501 12-01)

Among the more important electrical tests that may be used to determine the quality of a relay are: pull in voltage or current, release voltage or current, operate time, release time, coil resistance, insulation resistance, dielectric strength, contact resistance, contact bounce on operate, and contact bounce on release. The Model 8555 Automatic Relay Test Set is capable of performing all these tests on polarized or nonpolarized, single or double coil, voltage or current operated relays having 1 to 6 double throw poles. A functional block diagram is given, and a panel layout drawing showing all operating and limits controls is shown. Author

N64-19528 Consolidated Electronics Industries Corp., Frederick, Md.
BUILDING-BLOCK APPROACH TO AUTOMATION OF RELAY TEST EQUIPMENT
Kurt Botker *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 17 p refs (See N64-19501 12-01)

This paper is concerned with the electrical tests that are performed as part of a relay manufacturer's usual inspection program and are normally part of an acceptance testing program. These measurements are: winding resistance; dielectric strength; insulation resistance; contact resistance; operating characteristics, including operate and release values and sometimes hold and nonoperate values; operate and release times and possibly transfer and other timing measurements; and contact bounce time. A system of relay testing is described in which the approach is toward automation of individual tests with rapid loading and unloading in the test fixtures, as opposed to a fully programed system in which all tests are performed on a relay in sequence in one loading into the system. Author

N64-19533 Alloy Surfaces Co., Inc., Wilmington, Del.
STEEL DECARBONIZING AND ROWLAND RING DATA AS EFFECTS OF CHROMIUM DIFFUSION TREATMENT
John E. O'Brien *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 9 p refs (See N64-19501 12-01)

The paper discusses chromium diffusion treatment in terms of metallurgy and surface effects rather than the chemistry of the process, which utilizes a gaseous method instead of the classical "cement" or ceramic pack method. Chromium diffusion proved to benefit induction and permeability. Carbon was reduced from 0.010% to less than 0.005% and, in cross-section thicknesses of 0.0359 inches, to less than 0.001%. Other advantages of chromium diffusion treatment are: uniform deposition on all surfaces; little likelihood of pinholing; moderate forming, staking, crimping, etc. does not cause rupture of the case; air gaps are predictable and stable; and there is a definite reduction in cost factors. A.W.

N64-19537 Westinghouse Electric Corp., Baltimore, Md. Westinghouse Defense Center
INSTRUMENTATION FOR MASS RELAY LIFE TESTING
J. K. Scott and C. V. Leach *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 22 p (See N64-19501 12-01)

The relay styles in the test program ranged from 2 through 6 poles. Water-cooled loads were chosen for experimentation. Five load banks were designed to use modified wire-wound potentiometers. Each load bank contained 75 pots of various wattages and resistances wired to a panel of banana jacks. A 4-deck 26-position stepping switch controlled by a timer was used for monitoring contacts. A recycling system of monostable multivibrators with coincident outputs was used to monitor contacts subject to a loss of continuity due to shock or vibration. The operate-release time monitor was an NE-2 relaxation oscillator with a variable time constant of from 7.5 milliseconds to 0.18 second. A.W.

N64-19539 Radio Corp. of America, Camden, N.J.
RELAY DEGRADATION — A NEW RELIABILITY TOOL
Bernard R. Schwartz and Arthur Siegel *In* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 12 p (See N64-19501 12-01)

Experiments in the use of degradation as the basis of predicting future failures in relays were carried out as follows: the relay was placed in a chamber, whose ambient was that

of the maximum temperature rating for the relay, in order to encourage gaseous contamination from the coil; the next area of observed difficulties was at minimum rated temperature; then a simple run-in was chosen with contacts monitored for each operation. At the start of the tests, various parameters were measured, and, after each exposure, these measurements were repeated and changes noted. Relays having parameter changes greater than that allowable were rejected. From these experiments it was possible to set up a controlled reliability relay screening specification. A.W.

N64-19547 Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE, TYPE 2N1016B SILICON ALLOY TRANSISTOR Quarterly Progress Reports Nos. 5 and 6, Period through December 31, 1963
J. R. Forys, R. W. France, and R. J. Pisarcik [1963] 40 p
(Contract DA-36-039-SC-86743)
(AD-436328)

Information concerning the completion of five phases of process improvement is discussed. The substitution of one phase is mentioned. Additional information concerning the step stress program is presented. Author

N64-19596* Midwest Research Inst., Kansas City, Mo.
DEVELOPMENT OF SOLID FILM LUBRICANTS FOR USE IN SPACE ENVIRONMENTS
Vern Hopkins and Donald Gaddis [1963] 24 p Presented at USAF Aerospace Fluids and Lubricants Conf., San Antonio, Tex., Apr. 1963
(NASA Contract NAS8-1540)
(NASA CR-53835) OTS: $2.60 ph

This research program is concerned with the development of inorganic solid film lubricants suitable for service in space environments. Friction coefficients are given for many potential lubricants subjected to a light load and temperatures from 80° to 400° F in both a normal air atmosphere and in a vacuum of 10^{-6} torr. The main criterion for judging the performance of a potential lubricant film was the friction coefficient, which must be less than that obtained for a 0.001-in.-thick film of gold. The following lubricant films exhibited lower overall friction coefficients than a 0.001-in.-thick gold film: MoS_2 + graphite + bismuth–sodium silicate; MoS_2 + graphite + gold–sodium silicate; MoS_2 + graphite + molybdenum–sodium silicate; MoS_2 + graphite–sodium silicate; and MoS_2 + graphite–sodium phosphate. Author

N64-19643 AiResearch Mfg. Co., Phoenix, Ariz.
BEARING TESTS FOR THE SPUR TURBOGENERATOR
J. H. Dannan and J. G. Castor Wright-Patterson AFB, Ohio, Aero-Propulsion Lab., Mar. 1964 114 p refs
(Contract AF 33(657)-8954)
(APL-TDR-64-27; SY-5464-R; AD-437151)

The results of the liquid-potassium journal-bearing test program for the SPUR turbogenerator are presented. The activities described include the design, assembly, and checkout of the bearing test rig, and the results of a successfully completed 250-hour endurance test on a hydrodynamic journal bearing using 600° F liquid potassium as the lubricant. Unidirectional loads from 6 to 25 lbs were applied to the bearing operating at a speed of 24,000 rpm. In general, the data for film thickness versus load, attitude angle versus eccentricity ratio, and the associated bearing stiffness correlate well with established hydrodynamic theory. Author

N64-19666 Motorola, Inc., Phoenix, Ariz.
RESEARCH AND DEVELOPMENT FOR SURFACE PROTECTION OF SEMICONDUCTOR DEVICES Final Report
M. A. Hall, H. W. Cooper, and S. S. Flaschen 14 Dec. 1963 188 p refs
(Contract AF 19(604)-8358)
(AFCRL-64-188; AD-437399)

A controlled ambient program, affecting the atmosphere in the package above the semiconductor surface, stabilized and also optimized the electrical parameters of the devices. This was accomplished by controlling the concentration and distribution of water molecules at the surface in the vicinity of the junction. Various glasses, prepared by sputtering and other means, were used to provide a relatively impermeable barrier to seal the surface and junction areas. The carrier states at the surface of the semiconductor were effectively controlled and stabilized by both surface solution treatments and by controlled ambient techniques. Understanding and control of semiconductor properties beneath the surface were developed in the study of accelerated oxidation passivation of silicon transistors. Oxidation-induced dopant redistribution effects were also studied in this program. Author

N64-19726* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DESIGN AND OVERALL PERFORMANCE OF AN AXIAL-FLOW-PUMP ROTOR WITH A BLADE TIP DIFFUSION FACTOR OF 0.43
James E. Crouse and Donald M. Sandercock Washington, NASA, May 1964 30 p refs
(NASA TN D-2295) OTS: $0.75

A 0.7-hub-tip-ratio axial-flow-pump rotor with blade diffusion factors of 0.43 at the tip and 0.69 at the hub was designed by a blade-element technique and tested in the water tunnel. At the design flow coefficient of 0.284, a measured overall head-rise coefficient of 0.282 and an overall hydrodynamic efficiency of 0.937 were obtained. The design point, however, lies very close to a limiting operating condition as evidenced by excessive vibrations in the low-flow regime. Limited cavitation data are also presented. Author

N64-19779 General Electric Co., Cincinnati, Ohio Missile and Space Div.
DYNAMIC SHAFT SEALS IN SPACE Quarterly Report No. 6, Period Ending Oct. 15, 1963
[1963] 26 p refs
(Contract AF 33(657)-8469)
(AD-429211)

Work described includes a theoretical investigation of rotating fluid ring seals, investigations of DZL and squeeze seals, work on the liquid-metal seal test rig and facility, and test electron-beam welding of Rex 49 material. R.L.K.

N64-19943* General Electric Co., Cincinnati, Ohio Missile and Space Div.
MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report No. 1, 22 Apr.–22 Jul. 1963
R. G. Frank [1964] 95 p refs
(NASA Contract NAS3-2534)
(NASA CR-54006) OTS: $8.60 ph

Chemical, mechanical, and physical properties of seven major classes of materials were completed from data obtained from the literature and from material producers. A group of 35 materials were recommended for testing. Selection of the

specific materials was made on the basis of chemistry, producibility, or some specific property that is inherent in a particular material. Preliminary test plans for the corrosion, hot hardness, compression, thermal expansion, dimensional stability and friction and wear investigations, and for the purification and analyses of potassium, were prepared for submission to NASA for review and approval. One of the vacuum systems, to be used for the corrosion investigation, consists of a bakable 24-in.-diam × 54-in.-high chamber with a 1,000 l/sec getter-ion pumping system that was checked out in the 10^{-10} torr range. The second vacuum system consists of a bakable 18-in.-diam × 30-in.-high chamber, also with a 1,000 l/sec getter-ion pumping system. The third system, to be used for the compression tests, will consist of a specially designed vacuum chamber and load train with a mechanical strain measuring system. Considerable effort was devoted to the design of the vacuum friction and wear test apparatus to meet the required test conditions. Author

N64-19944* General Electric Co., Cincinnati, Ohio Missile and Space Div.
MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report No. 2, Jul. 22, 1963-Oct. 22, 1963
R. G. Frank, ed. [1963] 40 p refs
(NASA Contract NAS3-2534)
(NASA CR-54007) OTS: $3.60 ph

NASA approved 14 materials for inclusion in the program. These include one nonrefractory alloy, two refractory metals and alloys, three nonrefractory metal-bonded carbides, four refractory metal-bonded carbides and four pure compounds. The literature search and data compilation of properties of the candidate materials was continued. Preliminary test plans for seven test programs were submitted to NASA for approval, including potassium purification and analyses, corrosion, dimensional stability, hot hardness, compression, thermal expansion, and friction and wear in vacuum, and that approval was received. Component parts of the purification train have been ordered. The design for the isothermal capsule corrosion facility was completed, and detail drawings are being prepared. The design for the dimensional stability test program was initiated. The fabrication of the vacuum chamber for the compression testing facility was completed. The design for the high vacuum friction and wear tester was completed, and detail drawings are in process. The high vacuum chamber and pumping system was checked out at 6 × 10^{-10} torr—cold, dry, and empty. Author

N64-19952 Baird-Atomic, Inc., Cambridge, Mass.
LUBRICATION IN SPACE
Warren A. Salmon and Henry Scammell (Little (Arthur D.), Inc.), ed. [1963] 122 p refs Proceedings of a symp. held at Cambridge, Mass., 7-9 Feb. 1962

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N64-19956* Rochester U., N.Y.
THE GRIND-MILLING OF LIGHT WEIGHT MIRRORS OF GLASS Interim Progress Report, 1 Sep.-30 Nov. 1963
N. Hochgraf [1963] 18 p refs
(NASA Contract NASr-14)
(NASA CR-53881) OTS: $1.60 ph

A method is described for grinding out pockets in a solid block of glass to produce a lightweight ribbed structure that might be used as a mirror blank. Author

N64-19966 General Electric Co., Lynn, Mass. Lubrication Div.
GEOMETRY EFFECTS ON THE THRESHOLD OF HALF-FREQUENCY WHIRL IN SELF-ACTING, GAS-LUBRICATED JOURNAL BEARINGS
B. Sternlight (Mech. Tech., Inc.) and L. W. Winn Repr. from J. Basic Eng. [1963] p 1-8 refs Presented at Lubrication Symp., ASME, Boston, 2-5 Jun. 1963
(Sponsored by ONR)
(ASME Paper 63-LubS-2)

It has been shown that half-frequency whirl is influenced by orifice location, number of grooves, groove location, and so on. This paper presents test results that show the effect of geometry on the threshold of half-frequency whirl. The following bearing configurations were tested: (1) plain journal bearings with one orifice centrally located; (2) grooved journal bearings with two axial grooves; (3) grooved journal bearings with three axial grooves; and (4) grooved journal bearings with three axial grooves and six orifices. In addition, load-carrying capacity and attitude angle for the plain cylindrical and the two- and three-axial-groove bearings with two groove positions are given. Author

N64-19993* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HOT-PRESSING MIXED CARBIDES OF Ta, Hf, AND Zr
John J. Fischer Repr. from Am. Ceram. Soc. Bull., v. 43, no. 3, 7 Mar. 1964 p 183-185 refs
(NASA RP-162)

This is a description of tests made to determine the effects of the hot-pressing variables, temperature, pressure, and time on the density and grain size of two compositions, 4TaC · 1HfC and 4TaC · 1ZrC. The materials were compacted by hot-pressing in graphite dies. The temperature of pressing was varied from 3,450° to 4,800° F, the pressure from 1,000 to 7,000 psi, and the time from 1 to 60 min. The hot-pressed pieces were in the shape of cylindrical disks, 5/8 in. in diameter by approximately 1/4-in. thick. IAA

N64-19996 Bureau of Mines, Salt Lake City, Utah Salt Lake City Metallurgy Research Center
ALKALINE LEACH PROCESSING OF A SUBGRADE CALCAREOUS URANIUM ORE
K. E. Tame 1964 16 p refs
(BM-RI-6409)

An alkaline leaching procedure for recovering uranium from a submarginal 0.1 percent U_3O_8 calcareous carnotite ore from the Shiprock, N. Mex., area was investigated. A recovery of 72 percent of the uranium was attained in a preliminary test embodying the commonly accepted practice of (1) alkaline leaching at 90° C, (2) multiple stage filtration and washing for recovery of a clear pregnant solution, and (3) caustic precipitation of uranium as sodium diuranate, with recycle of the barren solution to the leaching and washing circuits. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-19302 Joint Publications Research Service, Washington, D.C.
PRODUCTION OF CLAD STAINLESS STEEL
F. A. Ksenzuk and N. A. Troshchenkov 30 Apr. 1964 12 p Transl. into ENGLISH of Ch. 10 of the book "Prodata i Otdelka Polosovoy Nerzhaveyushchey Staley" Moscow, Metallurgizdat., 1963 p 190–196
(JPRS-24422; OTS-64-31183) OTS: $0.50

Two-layer steel is usually prepared with the main layer made of steel brands 10, 15k, 20k, St.3, 12 Khm, 15M, and the plating layer of stainless steel brands OKh18N10, Kh18N9T, Kh17N13M2T, Kh17N13M3T, and OKh13. Calculations are given for the thickness and weight of the plate. Preparation of the plates and blanks, and casting, heating, and rolling of the two-layered ingots by several methods are described. R.L.K.

N64-19312 MSA Research Corp., Callery, Pa.
THERMOPHYSICAL PROPERTIES OF RUBIDIUM AND CESIUM
F. Tepper, A. Murchison, J. Zelenak, and F. Roehlich [1963] 42 p refs Presented at the 3d Ann. Liquid Metal Heat Transfer Technol. Conf., Oak Ridge, Tenn., 4–6 Sep. 1963
(MSAR 63-116)

The following are included: (1) alkali metal analysis; (2) vapor pressure of rubidium; (3) vapor pressure of cesium; (4) density of liquid rubidium; (5) density of liquid cesium; (6) pressure–volume–temperature of the vapor; (7) specific heat of liquid rubidium; (8) specific heat of cesium; (9) viscosity of vapor; (10) thermal conductivity of the liquid; and (11) specific heat and thermal conductivity of vapor. R.T.K.

N64-19318 Centre National de Recherches Metallurgiques, Liège (Belgium)
ON STUDY OF FATIGUE DAMAGE THROUGH NON-DESTRUCTIVE PROCESS [SUR L'ETUDE PAR VOIE NON DESTRUCTIVE DE L'ENDOMMAGEMENT PAR FATIGUE]
R. Salkin May 1963 13 p refs In FRENCH; ENGLISH summary Presented at the 3rd Meeting of ICAF-AGARD, Rome, Apr. 1963
(RA-254/63; ICAF-232)

Dynamagnetic tests were conducted on steel specimens during low-frequency tension-compression fatigue, to investigate structural modifications during the first 1,000c of fatigue. Various high-strength steels were subjected to continuous observation of their cycle-to-cycle magnetostrictive response to mechanical solicitations, using a coil surrounding the specimen and connected to a recorder. The results were representative of increasingly hindered motions of Weiss domains. Relation to fatigue damage may be based on assuming that domains break when the slip bands appear. Author

N64-19441 Joint Publications Research Service, Washington, D.C.
STRUCTURE AND PROPERTIES OF URANIUM, THORIUM AND ZIRCONIUM ALLOYS
O. S. Ivanov, ed. 24 Apr. 1964 42 p Transl. into ENGLISH of 5 chapters of the book "Stroyeniye i Svoystva Splavov Urana, Toriya i Tsirkoniya" Moscow, Gosatomizdat, 1963 p 16–21, 47–76, 294–298
(JPRS-24347; OTS-64-31154) OTS: $1.25

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N64-19442 Joint Publications Research Service, Washington, D.C.
URANIUM CORNER OF THE U-Al-Fe PHASE DIAGRAM
D. K. Khakimova, O. S. Ivanov and Yu. S. Virgil'yev *In its* Structure and Properties of Uranium, Thorium and Zirconium Alloys 24 Apr. 1964 p 1–6 (See N64-19441 12-18) OTS: $1.25

The joint solubility of aluminum and iron in uranium was determined. The microstructure of alloys quenched from various temperatures was investigated. Quenching of alloys was done in water at room temperature. At this time, the γ-phase was not fixed, and the γ to β or β to γ transformation was studied. Results of microstructure phase analysis were plotted on a concentration triangle, using data on solubility of aluminum and iron in binary systems of U-Al and U-Fe to construct isothermal sections of the U-Al-Fe system. Isothermal sections at 650° C, 690° C, 730° C, 760° C, 775° C, 800° C, 850° C, 970° C, and 1,050° C were plotted. Identification of the precipitated phases $j_1(UAl_2)$ and j_2 (U_6Fe) was possible due to their behavior during electrolytic polishing with an electrolyte. R.T.K.

N64-19443 Joint Publications Research Service, Washington, D.C.
EFFECT OF REPEATED QUENCHING ON CRACKING OF URANIUM ALLOYS
A. T. Semenchenkov and O. S. Ivanov *In its* Structures and Properties of Uranium, Thorium and Zirconium Alloys 24 Apr. 1964 p 7-20 (See N64-19441 12-18) OTS: $1.25

Repeated quenching of alloys of various composition in cold and boiling water and in Wood's alloy at 100° to 200° F from the γ(900° F)- and β(720° F)-regions showed that cracking of alloys during repeated quenching corresponds with preservation of the β-phase in them. Cracks occur during quenching and not during the $\beta \rightarrow \gamma'$ transformation during tempering. Faster cooling in quenching facilitates preservation of the β-phase and cracking of alloys. A direct cause of cracking is the action of stresses in a sample during quenching causing a temperature gradient in the β-phase. When quenching from the β-region, the tendency of alloys to crack is weaker. When quenching from the β-region in oil at 200° F a slower cooling rate is created at which the β-phase is not preserved and no cracks are formed. Oil quenching is a satisfactory process for all low-alloy uranium alloys. The tendency of alloys to crack can be eliminated or reduced to a small degree by alloying with 3% to 5% Zr, 2% to 3% Nb, and 3% to 5% Ti with additional alloying with 1% Si or Fe and 1% to 1.5% fissium. Author

N64-19444 Joint Publications Research Service, Washington, D.C.
KINETICS OF TRANSFORMATION BY SHARP QUENCHING OF THE β-PHASE IN ALLOYS OF URANIUM WITH ALUMINUM, SILICON, IRON, NICKEL, MOLYBDENUM, AND FISSIUM
A. T. Semenchenkov and O. S. Ivanov *In its* Structures and Properties of Uranium, Thorium and Zirconium Alloys 24 Apr. 1964 p 21-28 (See N64-19441 12-18) OTS: $1.25

The β-solid solution, fixed by quenching alloys of uranium with aluminum, silicon, iron, nickel, molybdenum, and fissium to 68° F, is transformed to the γ' phase at room temperature and at 100° and 150° F. Increase of holding temperature from room to 150° F reduces transformation time. An exception is the alloy with 1.5% fissium, which is highly stable even when held at 150° F for 45 days. The isothermal transformation diagrams at 25° to 670° F show that uranium with 1% silicon has a high rate of transformation above 150° F. The stability of uranium with 1% fissium is sharply increased, and the isothermal diagram is characterized by the presence of two branches having different transformation characters—martensite (bottom branch) and diffusion (top branch). Minimum stability of the β-phase is observed at 250° and 600° F, while between 280° and 400° F, no β- γ' transformation was observed over a 24-hour period. The S-curve for uranium with 1.5% fissium has only a high-temperature branch of the β-γ' transformation. By increasing temperature from 400° to 600° F, transformation rate is sharply increased. Below 400° F the β-phase is stable for one day. Author

N64-19445 Joint Publications Research Service, Washington, D.C.
STATE OF IMPURITIES WITH RESPECT TO TEMPERING TEMPERATURE OF QUENCHED URANIUM ALLOYS
A. T. Semenchenkov and O. S. Ivanov *In its* Structures and Properties of Uranium, Thorium and Zirconium Alloys 24 Apr. 1964 p 29-35 (See N64-19441 12-18) OTS: $1.25

Alloying elements that are dissolved in γ-uranium at 900° F will be retained in β- or α-solid solutions when quenched and then tempered at 100° F. When tempering at higher temperatures (300° to 500° F), those elements dissolved in the β- or α-phase will precipitate from solution as can be judged by increase in hardness and drop in resistivity. The β-α transformation that develops in tempering at 100° to 150° F is also reflected in the magnitude of resistivity and hardness. Author

N64-19446 Joint Publications Research Service, Washington, D.C.
CORROSION PROPERTIES OF Th-Zr-Nb ALLOYS
T. A. Badayeva and G. K. Alekseyenko *In its* Structure and Properties of Uranium, Thorium and Zirconium Alloys 24 Apr. 1964 p 36-39 (See N64-19441 12-18) OTS: $1.25

Experiments on the corrosion of alloys quenched from the $^{\beta}$Th$^{\beta}$Zr$^{\beta}$Nb-solid solution in water showed good corrosion resistance when tested at 300°, 350°, 400°, and 500° F for 1,000 hours, especially those alloys of zirconium containing 1% to 15% Th. For example, alloys with 95% Zr + 1% Nb, 70% Zr + 15% Nb, and 54% Zr + 45% Nb did not rupture after 1,000 hours at 400°, while at the same time, unalloyed zirconium started to break off at 350°. All alloys were destroyed after testing for 300 hours at 500°. Alloys containing more than 95% Zr + 1-5% Th and those alloys along the Zr-Nb side containing 45.55 and 65% Nb with 1-0.5% Th are fairly resistant to oxidation in air (unalloyed zirconium excepted). For example, alloys with 98% Z + 1% Nb, 54% Zr +45% Nb, and 45% Zr + 54% Nb held up at 400° for 1,000. At 600° all the studied alloys were destroyed. Author

N64-19449 Joint Publications Research Service, Washington, D.C.
MAGNIFICATION OF 18-8 STAINLESS STEEL CRYSTAL CORROSION IN LOW CHROMIUM AREAS
Hua Pao-ting, Shen Hsing-su, Tsou Chung-chien, Li Kuei-chish, and Hsi Shu-yun *In its* Transl. on Communists China's Sci. and Tech., No. 80 27 Apr. 1964 p 6-10 refs (See N64-19447 12-01) OTS: $2.00

A sample of 18-8 steel [C (0.125%), Cr-17(71%), Ni(8.2%), Mn (0.84%), and Si (0.32%)] was treated at 650° C for 2 hours, then placed in a $1NH_2SO_4$ solution at 25° C, and made to carry an electric current by maintaining a regulated potential across the specimen of +134 millivolts. Analysis of the curve of polarization showed that under the electric current, low temperature, and solution, the crystals could remain completely pure while the crystal boundaries are activated. After the experiment was completed, the surface of the steel retained its metallic luster, and no crystal corrosion was observed when the specimen was placed under a 500-X microscope. After the specimen was slightly bent, however, crystal corrosion was observed. P.V.E.

N64-19578* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE INFLUENCE OF NUCLEAR RADIATION ON MATERIALS TECHNOLOGY FOR SPACE APPLICATIONS
Lowell K. Zoller 25 Oct. 1963 21 p refs Presented at the 66th Ann. Meeting of the Am. Soc. for Testing and Mater., Atlantic City, 23-28 Jun. 1963
(NASA TM X-51615; MTP-P&VE-M-63-15) OTS: $2.60 ph

This paper defines the various material categories and the associated combinations of environments that must be investigated and discusses some modifications of accepted test methods, including radiation dosimetry. Author

N64-19626 Battelle Memorial Inst., Columbus, Ohio
FURTHER DEVELOPMENT OF A DUCTILE TUNGSTEN-BASE SHEET ALLOY Third Quarterly Progress Report, 8 Aug-8 Nov. 1963

J. L. Ratliff, R. N. Orava, D. J. Maykuth, H. R. Ogden, and R. I. Jaffee 18 Dec. 1963 43 p refs
(Contract N600(19)-59738)
(AD-426224) OTS: $4.60

Two groups of ternary alloys were prepared and evaluated. In the first group certain difficulties associated with sintering and fabrication were defined. Work with the second group of alloys resolved some of the prior problems and was also successful in showing significant property advantages for the W-(3 and 5)Re-2ThO_2 alloys prepared from commercially doped type 218 powder. The W-5Re-ThO_2 class of alloys was selected for further study. Author

N64-19627 Nuclear Metals, Inc., West Concord, Mass.
BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM Quarterly Progress Report, 1 Jan.-31 Mar. 1963
Aug. 1963 31 p refs
(Contract AF 33(616)-7065)
(AD-432452)

The strength and ductility above room temperature of the hot-pressed Brush and Pechiney powders show the usual behavior for beryllium. This material exhibits little response to aging heat treatments. Extruded Brush and Pechiney beryllium possess greater strength and ductility in the transverse direction than in the longitudinal direction at temperatures below about 20° C. This appears to be due to twinning in the longitudinal specimens. Tensile specimens are being prepared from single crystals of SR Pechiney and of single distilled beryllium. These crystals were obtained from metal melted and slowly cooled in BeO crucibles. Author

N64-19647 IIT Research Inst., Chicago, Ill.
YIELDING IN POLYCRYSTALLINE METALS
William Rostoker Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Jun. 1963 38 p refs
(Contract AF 33(657)-7650)
(ARL 63-245; AD-436804)

Stress–microstrain studies of Ni, Fe, and Fe-3% Si have been conducted on materials with various grain sizes. The microyield stress (1 μin. plastic strain) has been shown to depend on grain size in Ni and Fe-3% Si in the same manner as the macroyield. On the other hand, the microyield stress of Fe seems to be nearly independent of grain size. Author

N64-19654 Aeronautical Systems Div., Wright-Patterson AFB, Ohio Metals and Ceramics Div.
EFFECTS OF THERMAL-MECHANICAL PROCESSING VARIABLES ON SHORT-TIME 3000°F TENSILE PROPERTIES OF TUNGSTEN + 0.6 PERCENT COLUMBIUM ALLOY
Vincent De Pierre and George Saul Aug. 1963 36 p
(ASD-TDR-63-782; AD-420591)

The effects of thermal–mechanical processing variables on short-time 3000° F tensile properties of tungsten + 0.6 percent columbium alloy were determined by correlating both tensile properties and thermal–mechanical variables with microstructure and cold work condition of this alloy. From these correlations the spread in 3,000° F tensile and yield strength values (22,000 to 63,310 psi and 10,500 to 61,500 psi, respectively) is attributed to variations in processing factors and time at 3,000° F during tensile testing. The correlations also serve as a guide for processing the alloy and for evaluating the alloy suitability for 3,000° F service application. Author

N64-19767 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE PASSIVATION AND CORROSION RESISTANCE OF STAINLESS STEEL
Milan Prazak and Vilem Prazak 5 Mar. 1964 21 p refs Transl. into ENGLISH from Hutnicke Listy (Prague), v. 11, no. 2, 1956 p 91–97
(FTD-TT-64-20/1+2; AD-433196)

Solving the basic problems of the electrochemical corrosion mechanism and establishing corrosion-resistance conditions of refined steel with a chromium content are discussed. The causes of stainless steel corrosion resistance are given. With the method of potential polarization, it is possible to establish values for corrosion behavior of stainless steel. The resulting data are helpful in investigating corrosion resistance. Using both theory and accurate instruments, the development of corrosion-resistant alloys is greatly simplified. G.D.B.

N64-19769 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CREEP OF STEEL OF VARIOUS ALLOYING DEGREES
M. P. Braun and B. B. Vinokur 2 Mar. 1964 6 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 9, 1963 p 1190–1193
(FTD-TT-64-48/1+2; AD-433583)

Results of laboratory investigations of steels that contain various amounts of nickel and tungsten or molybdenum are discussed. Samples were heat treated and then investigated for creep at 450° to 500° C for a period of 2,000 hours at loads of 6 to 12 kg/mm^2. The results showed that in these temperature ranges steel 35KHGNV (A) (C—0.39%, Si—0.32%, Mn—0.90%, Cr—0.77%, Ni—1.03%, W—0.52%) showed good resistance to creep. Steel 35KHGNV (B) (C—0.39%, Si—0.29%, Mn—1.21%, Cr—0.99%, Ni—1.50%, W—0.52%) had a rate of creep of approximately the same as 35KHGNV (A) (10^{-5}% to 10^{-4}%/hr). The creep of chromium–molybdenum steel was also investigated along with the creep of a steel with a 3%-nickel addition; it was found that up to a temperature of 500° C, the steel with nickel addition has a much higher creep boundary than the chromium–molybdenum, and that above 500° C the reverse is true. P.V.E.

N64-19880* Rice U., Houston, Tex.
ANALYSIS OF THE VARIATION OF THE DIFFUSION CONSTANT OF CARBON IN AUSTENITE WITH CONCENTRATION
R. M. Asimow Repr. of the Transactions of the Metallurgical Soc. of AIME, v. 230, Apr. 1964 3 p
(NASA Grant NsG-6-59)

The increase of the diffusivity of carbon in austenite with increasing carbon concentration is investigated in terms of: the concentration dependence of the activity coefficient of carbon in austenite, and the negative pressure caused by the interstitial carbon atoms. In the latter term, the activation free energy for diffusion is not directly a function of concentration if it is considered that the alloy is subjected to a concentration-dependent pressure. An equation is given for the diffusivity of carbon, taking into account the change in activity coefficient with concentration. On dividing uncorrected diffusion data by this equation, to account for the variation of the activity with concentration, the diffusivity varies much less with concentration. By dividing by the additional exponential factor exp(KC), the diffusivity becomes essentially independent of concentration. It is seen that, considering the qualitative nature of the discussion, the excess variation of the diffusion constant is explained very well on the basis of lattice strains caused by the interstitial carbon atoms. C.L.W.

N64-19927 Materials Research Corp., Orangeburg, N.Y.
THE MECHANICAL PROPERTIES OF TANTALUM WITH SPECIAL REFERENCE TO THE DUCTILE-BRITTLE TRANSITION Technical Report [1 Apr. 1962-1 Apr. 1963]

G. Abowitz and R. A. Burn Wright-Patterson AFB, Ohio. ASD. May 1963 65 p refs
(Contract AF 33(616)-7173)
(ASD-TR-61-203, Pt. III; AD-424683)

The tensile behavior of single phase tantalum–hydrogen alloys and tantalum–molybdenum alloys containing dilute additions of molybdenum has been studied as a function of grain size and alloying addition. Uniaxial tension tests were carried out at 25° C and −196° C, the strain rate, ϵ, being fixed throughout the experiments at 10^{-3} sec^{-1}. The parameters σ_i and k_y of the Petch equation were evaluated where possible. It was observed that σ_i, the lattice friction stress, was essentially independent of hydrogen content at room temperature whereas k_y, which was presumably a measure of the solute-dislocation interaction, was observed to increase by the absorption of hydrogen into tantalum. The addition of small amounts of Mo to Ta results in an increase in k_y at 25° C, which can be attributed to a Mo-dislocation interaction. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-19361* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME EFFECTS OF THE SPACE ENVIRONMENT OF THE PHYSICAL INTEGRITY OF PLASTICS
John A. Parker, Hermilo R. Gloria, and Jerome J. Lohr *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 58–64 (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

The weight-loss phenomenon of heterogeneous solids in vacuum has been investigated. Specifically, composites of a sublimable inorganic solid, ammonium fluoroborate, and cross-linked polymer systems, which included a cast elastomer and an epoxy plastic, have been studied under programed and constant temperature conditions. Quantitative isothermal experiments were conducted in a chamber with liquid-nitrogen cooled walls at a pressure of 1×10^{-6} torr. Examination of the vapor phase chromatography of outgassed material and comparison of the weight-loss processes, by means of thermograms, with those of composites of known constitution have established that the principal component lost under these conditions was the inorganic solid. Analysis of the rates of weight loss of the sublimable component showed two sequential mechanisms for the weight-loss processes. The first, the most rapid, is believed to be the sublimation of the inorganic solid exposed at the surface of the composite. The second part of the weight-loss process, sublimation, sorption, and diffusion of sublimate through the encapsulating polymer film, has been found to be a function of the concentration of sublimate, the polymer type, the temperature, and the sample geometry. Author

N64-19481 Aerospace Corp., El Segundo, Calif. Materials Science Lab.
YIELDING AND FLOW OF SAPPHIRE (α-Al_2O_3 CRYSTALS) IN TENSION AND COMPRESSION
H. Conrad, G. Stone, and K. Janowski 15 Apr. 1964 37 p refs
(Contract AT(11-1)-GEN-8)
(ATN-64(9236)-15)

The available data on the dynamics of plastic flow of sapphire indicate that the deformation rate $\dot{\gamma}$ in the temperature range from 900° to 1,700° C can be expressed either as (1) $\dot{\gamma} = A/T(\tau^*)^n \exp-(H_0/RT)$, or (2) $\dot{\gamma} = \nu \exp-[H(\tau^*)/RT]$, where A, n, and ν are constants. In Eq. (1), n is of the order of 3 to 7 and H_0 is 90 to 125 kcal/mole. In Eq. (2), H is 120 kcal/mole and $\nu^* = -dH/d\tau^*$ is $110b^3$ at $\tau^* = 1$ kg/mm^2, decreasing with stress. Assuming the presence of an excess of oxygen ion vacancies, Eq. (1) is in accord with Weertman's dislocation climb mechanism, whereas the results based on Eq. (2) support overcoming the Peierls–Nabarro stress as the rate-controlling mechanism. It is concluded that the available data are in better accord with Eq. (2) and the Peierls–Nabarro mechanism. Author

N64-19559 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
FERROELECTRIC BIBLIOGRAPHY SUPPLEMENT Technical Memorandum
Robert D. Hall, comp. 23 Aug. 1963 90 p refs
(Contract DA 36-039-AMC-00088(E))
(EDL-M557; AD-433653)

This supplement continues the sequence beginning with M 165 and M 351, and includes the articles in the appendix to M 351. There are 24 classifications given, among which are ferroelectrics by groups and compounds, antiferroelectrics, theory, dielectric properties, piezoelectric properties, radiation, single crystals, composition variations, applications, and patents. A.W.

N64-19605* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN
C. F. Key and W. A. Riehl 4 Dec. 1963 95 p refs
(NASA TM X-54611; MTP-P&VE-M-63-14) OTS: $8.60 ph

The test instrument and procedure developed by Lucas and Riehl were used to determine the compatibility of a wide variety of materials with liquid oxygen (LOX). This method is based upon the tendency of materials to react with LOX on impact and is commonly known as the "ABMA Tester." Pertinent data from these tests have been compiled, and the findings are presented in this report. Materials are discussed according to the following classifications: (1) lubricants, (2) sealants and threading compounds, .3) thermal and electrical insulation, (4) elastomers, plastics, and adhesives, (5) gaskets and packing, (6) metals, alloys, and solders, (7) dye penetrants, and (8) solvents, cleaning solutions, and miscellaneous. Author

N64-19613* ARDEL Corp., Los Angeles, Calif.
EVALUATION OF INSULATED WIRE FOR SPACE ENVIRONMENT Final Report
Richard H. Suess and George R. Neff 7 Feb. 1963 Prepared for JPL 55 p
(NASA Contract NAS7-100)
(NASA CR-53815; Rept. 05132-4) OTS: $5.60 ph

Six candidate conductor systems have been evaluated in a simulated hyperspace environment. These included polyolefin, teflon, "H" film, polyvinyl fluoride, and polyimide insulation. The test results indicate that the teflon and polyimide systems performed the most satisfactorily in the test parameters used. Explanations of test methods, analysis of data, conclusions, and recommendations for possible future testing are included. Author

N64-19653 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Aero Propulsion Lab.

AN EXAMINATION OF METHODS FOR CALCULATING VAPOR PRESSURE OF PETROLEUM HYDROCARBON Technical Documentary Report, Apr.-Jul. 1963

William G. Scribner (Monsanto Res. Corp.), John H. Warren (Socony Mobil Oil Co.), Alan E. Zengel, and Herbert R. Lander Mar. 1964 27 p refs

(APL-TDR-64-37; AD-437285)

The purposes of this report are to compare the difficulty and accuracy of five techniques, of which three were basic calculation techniques and two were experimental techniques. Four independent workers calculated the vapor pressure–temperature relationship for one high-quality jet fuel and for one synthetic blend of seven pure hydrocarbons. The results demonstrate that the method of assuming segments of the true boiling point curve to be pure compounds and finding the total vapor pressure as the sum of the component partial pressures is precise to ±5 percent. The empirical technique developed by Edmister is less accurate (based on the comparison with experimental results) and less precise than the more laborious true boiling point curve technique. An empirical curve relating the 20-percent point to vapor pressure was found to be within ±10 percent of experimental results when applied to fuels with a Reid Vapor Pressure of less than 0.1 psia and a 5 percent to 95 percent ASTM distillation range of less than 200° F. Author

N64-19660 General Electric Co., Evendale, Ohio

CARBONIZATION OF PLASTICS AND REFRACTORY MATERIAL RESEARCH. VOLUME II, REFRACTORY MATERIALS Technical Report, 1 Jul. 1961-30 Jun. 1962

G. M. Kibler, T. F. Lyon, M. J. Linevsky, and V. J. De Santis Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 181 p refs

(Contract AF 33(616)-6841; ARPA Order 24-61)

(WADD-TR-60-646, Pt. III, Vol. II; AD-438050)

Vapor pressure studies have been conducted through the application of Langmuir evaporation, Knudsen effusion, matrix isolation, and resonance line absorption techniques. The vaporization of hafnium and zirconium nitrides was studied by the Knudsen effusion method; the Langmuir evaporation method was applied to pure hafnium metal. Matrix isolation of vapor over thoria proved successful, and structural assignments have been made to various bands in the infrared absorption spectra of the matrix isolated species. Resonance line absorption photometry studies of TiB_2 have been completed. Normal spectral emissivity data from 0.4μ to 5.0μ and from 1,500° to 2,500° K, supported by systematic methods of material characterization, have been obtained for the compounds niobium diboride, zirconium diboride, titanium diboride, tantalum nitride, hafnium nitride, and zirconium nitride. Author

N64-19736 Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.

ALKALI METAL RESISTANT WIRE Final Report

E. S. Bober, R. E. Stapleton, and W. H. Snavely Wright-Patterson AFB, Ohio, Aero-Propulsion Lab., 15 Apr. 1964 163 p refs

(Contract AF 33(657)-10701)

(APL-TDR-64-42; AD-436294)

A ceramic-coated conductor system was developed that was unaffected by 172 hr exposure to potassium vapor at 850° C. This system was Metco 201 zirconia, plasma sprayed on nickel-aluminide coated nickel-clad silver AWG 8 Sylvania wire. This system is not suitable for electrical operation at 850° C, since the resistance of the zirconia coating drops to 5 ohms at 600° C. Overcoating the zirconia with aluminum nitride by a vapor plating technique results in a resistance at 850° C in argon for the multicoat of 1.8×10^4 ohms. The aluminum nitride overcoated zirconia is unaffected by 172 hr exposure. Alumina, magnesia, and strontium zirconate were resistant to potassium vapor at 850° C. Loss of adhesion in the potassium vapor even when a nickel aluminide undercoat is used is a problem. Pre-potassium and postpotassium vapor (850° C) exposure resistance data on many materials were obtained. Data obtained on lead in insulators of test capsules indicate a decrease in surface resistivity. The lowered resistance of these insulators (10^4 ohms) is still in a useful range. Statorette adherence tests show several insulated conductors will withstand vibration, shock, and acceleration. Author

N64-19745 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

TRANSACTIONS OF THE INSTITUTE OF CONSTRUCTION AND CONSTRUCTION MATERIALS

2 May 1963 14 p refs Transl. into ENGLISH of 2 articles from Tr. Inst. Stroit. i Stroimaterialov, Izd. Akad. Nauk SSR, Alma Ata, no. 2, 1959 p 163–166, 179–182

(FTD-TT-63-275/1+2+4; AD-409063)

CONTENTS:

1. THE PROBLEM OF THE PRESENCE OF DEVITRITE IN FOAM GLASS R. L. Shuster and T. P. Polyakova p 1–6 refs (See N64-19746 12-19)

2. CONTENTS OF THE CRYSTALLINE PHASE IN FOAM GLASS IN RELATION TO CERTAIN FACTORS R. L. Shuster p 7–12 refs (See N64-19747 12-19)

N64-19746 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE PROBLEM OF THE PRESENCE OF DEVITRITE IN FOAM GLASS

R. L. Shuster and T. P. Polyakova *In its* Trans. of the Inst. of Construct. and Construct. Mater. 2 May 1963 p 1–6 refs (See N64-19745 12-19)

The basic crystallization phase of foam glass obtained by applying limestone or dolomite as a gasifier is devitrite. The interplanary spacings of the most intense Debye rings of X-ray photographs of devitrite are characteristic for its identification. The location of the indexes h, k, l, and crystal lattice constants of devitrite (rhombic) requires further special investigation. Author

N64-19747 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONTENTS OF THE CRYSTALLINE PHASE IN FOAM GLASS IN RELATION TO CERTAIN FACTORS

R. L. Shuster *In its* Transl. of the Inst. of Construct. and Construct. Mater. 2 May 1963 p 7–12 refs (See N64-19745 12-19)

Microscopic and X-ray diffraction methods were used to investigate the problem of the influence of the composition of foam-glass batches and their heat-treating condition on the composition and on the relative content of new crystalline formations in the foam glass. The investigation of foam glass with the introduction of limestone as a gasifier indicated that the glass is permeated with radial-fibrous aggregates of acicular crystals 10μ to 20μ long, intergrown into the glass matrix; the aggregates increase sharply in number with an increase of heating temperature from 760° to 820° C. The optical properties of the crystals are characterized by direct extinction, by positive lengthening, and by an index of refraction equal to: $\alpha = 1.575$, $\gamma = 1.560$. The investigation of foam glass with the introduction of dolomite as a gasifier indicated that the

foam glass contains crystals of devitrite, enstatite, and diopside; the number and size of the enstatite and diopside crystals (as isometric microcrystals) increase somewhat with a change of heating temperature from 760° to 860° C and with the content of dolomite in the mixture increased from 2% to 10%. P.V.E.

N64-19773 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
GENERAL RESEARCH: MECHANICAL BEHAVIOR OF SAPPHIRE
H. Conrad 23 Mar. 1964 40 p refs
(ATN-64-(9236)-14)

The present state of knowledge on the mechanical behavior of sapphire is reviewed. Sapphire deforms plastically at temperatures above 900° C, the most common mode of deformation being slip on the basal plane in the $<11\bar{2}0>$ direction; under certain conditions, slip may occur on prism planes or twinning may occur. A yield point is often observed. This is related to the multiplication of dislocations by a mechanism controlled by the motion of dislocations through the lattice, rather than by the tearing of dislocations from an impurity (or defect) atmosphere. The dynamics of yielding and flow is similar and can be expressed by either of two thermally activated equations. Fracture generally occurs on a plane approximately normal to the tensile stress, and the fracture surface is conchoidal. From 1,100° to 1,500° C, the tensile fracture stress decreases with increase in plastic strain, independent of temperature and strain rate. The mechanism of failure in this case is the interaction of edge dislocations with preexisting cracks. Author

N64-19801 Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
DIELECTRIC MATERIALS FOR HIGH TEMPERATURE EVALUATION Final Report, 15 Sep.-16 Dec. 1963
Joseph Green and Nathan Mayes [1963] 22 p refs
(Contract NObs 90065)
(RMD 5038-Q1; AD-429230)

Research was conducted toward the preparation of thermally stable carborane siloxane materials for use as embedding compounds and elastomers. Hydrocyclosiloxanes were prepared for subsequent conversion to the corresponding carborane cyclic compounds. A carborane cyclotetrasiloxane was prepared and polymerized. A linear carborane siloxane of >7,000 molecular weight was prepared and its thermal properties evaluated by DTA and TGA. Author

N64-19935 IIT Research Inst., Chicago, Ill. Technology Center
STUDY OF ATTACHMENTS FOR BRITTLE COMPONENTS, PHASE II Final Report, Nov. 1962-Oct. 1963
K. E. Hofer, Jr., N. Bredzs, R. Firestone, and J. Rudy 15 Nov. 1963 247 p refs
(Contract AF 33(657)-8339)
(AD-428202)

The three disciplines of mechanical fastening, adhesive bonding, and brazing are examined for their application to the problem of attachments in brittle nonmetallic materials. The ultimate objective of this program was to provide information for attachments of Al_2O_3 and TiB_2 aerospace components. A method for quantitative comparison of joints was proposed. Various joints were studied using this method, and the results were compared with the work of previous investigators. Significant advances in the art of brazing the two refractory nonmetallics were accomplished. Author

N64-19959* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DEGRADATION OF THE POLYACENAPHTHYLENE-SODIUM COMPLEX
A. Rembaum Repr. from J. Polymer Sci., v. 2, no. 1, Jan. 1964, p 117-121 refs
(NASA Contract NAS7-100)
(NASA CR-53503; JPL-TR-32-517)

Experimental evidence is presented that indicates that the electron spin resonance spectrum obtained from the polyacenaphthylene-sodium complex is due to the presence of monomeric acenaphthylene radical anion. Attempts at the chemical isolation of acenaphthylene from the degraded polymer were, however, not successful. R.T.K.

N64-19972 Aeronautical Systems Div., Wright-Patterson AFB, Ohio
MATERIALS FOR THE SPACE AGE
C. W. Douglass, D. H. Cartolano, Harold D. Colwick, and Robert L. Buchenauer Sep. 1963 31 p refs Presented at the ASD 1963 Sci. and Eng. Symp., Wright-Patterson AFB, Ohio, 18-19 Sep. 1963
(ASD-TDR-63-688; AD-428066)

In the space age, it is clear that Air Force systems of the future will be subjected to natural and induced environments never before encountered. Materials limitations are the pacing factor in successful development of required systems. To satisfy these requirements, a completely new level of materials technology has been created, based on using elements of matter never before explored, for future materials. Reference is made to the Periodic Table in identifying and assessing the parameters and key elements, which provide the baseline for materials research. To portray the vital role of materials, a review is made of several typical advance system concepts. The most critical materials problems, as represented by primary system components within the major areas of primary and secondary structure, environmental protection, electronics, and energy transfer systems are discussed. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-19320 European Atomic Energy Community, Brussels (Belgium)
THE MAXIMUM PRINCIPLE, ITS COMPUTATIONAL ASPECTS AND ITS RELATIONS TO OTHER OPTIMIZATION TECHNIQUES
W. De Backer Joint Nucl. Res. Center, Ispra Establ. (Italy), 1964 74 p refs Presented at a seminar on Optimal Control, CETIS (Italy), Apr. 1963
(EUR-590.e) Available from the Belgian American Bank and Trust Co., N.Y., Account no. 121.86: 100 Belg. Fr.

Pontryagin's principle and its relations to the principle of optimization of Bellman, to the classical calculus of variations, and to gradient methods (generalized gradient) are discussed. The synthesis of optimal systems on electronic computers is analyzed, especially those connected with the theory of penalty

functions, the two-point boundary problem, parameter optimization, and sensitivity analysis. The need of hybrid computation is underlined. Author

N64-19392 Research Triangle Inst., Durham, N.C.
DESIGNS FOR THE SEQUENTIAL APPLICATION OF FACTORS Technical Report No. 6
Sidney Addelman 13 Dec. 1963 11 p ref
(Grant DA-ARO(D)-31-124-G266)
(SU-56; AROD-2579-16; AD-426318) OTS: $1.60

Some experimental plans that are appropriate when the levels of the factors of the 2^n factorial experiments are applied sequentially are presented. These plans permit the estimation of the main effects and two-factor interactions of the 2^n experiment, and also of the effects of the different possible orderings of the factors. Author

N64-19395 Wisconsin U., Madison Mathematics Research Center
METHOD OF INDETERMINANT COEFFICIENTS IN LINEAR DIFFERENTIAL SYSTEMS AND THE MATRIX EQUATION XB – AX = U
A. Dou Mar. 1964 23 p refs
(Contract DA-11-022-ORD-2059)
(MRC-452; AD-427293)

The ordinary linear differential system with constant coefficients is considered. Theorem 1 states an explicit solution of the system in finite terms. Using this solution, Theorem 2 states a theoretical ground for the application of the method of indeterminate coefficients to obtain a particular solution of system. Theorem 3 analyzes a particular case. A correspondence is established between the differential systems and the matrix equation. Theorem 4 gives the general solution of the matrix equation obtained from results previously proven and from the general theory of differential systems of form. Author

N64-19398 Illinois U., Urbana Coordinated Science Lab.
AN ALGORITHM FOR THE SYNTHESIS OF LARGE SEQUENTIAL SWITCHING CIRCUITS
John Elsey May 1963 53 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-169; AD-418163)

This thesis develops and presents an algorithm for synthesizing asynchronous sequential switching circuits. The algorithm has certain properties that make it useful and applicable to large switching circuits such as the control unit of a digital computer. The steps in the algorithm are systematic and simple permitting a solution to be obtained in a relatively short time. The resulting design is not optimum in that the circuit has the minimum number of states or minimum amount of logic, but this is acceptable since it is in general impossible to find an optimum design in a reasonable time. Author

N64-19399 Illinois U., Urbana Coordinated Science Lab.
UPPER BOUNDS FOR THE MEAN LIFE OF SELF-REPAIRING SYSTEMS
Jean Kruus Jul. 1963 38 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-172; AD-418174)

Upper bounds are obtained for the mean life of a self-repairing system consisting of several identical machines, spare parts, and the necessary connecting and wiring mechanism. No detailed knowledge is assumed about the machines, except that each is by itself capable of performing the function required of the system, and that three of these machines may be interconnected to diagnose and direct the repair of a suspected fault in a fourth machine. The time required for diagnosis and repair is a random variable. Failures are detected by observing the outputs of machines operating in parallel. A difference in outputs indicates a fault. System mean life is obtained by selecting random machine lifetimes for a system simulated on an electronic computer; it is found to be quite sensitive to changes in the stress factor of spare machines. Author

N64-19400 Illinois U., Urbana Coordinated Science Lab.
ON THE SYNTHESIS OF OPTIMUM MULTIVARIABLE SYSTEMS
Ramakrishna Narayanasamy Jul. 1963 74 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-173; AD-418160)

The multivariable systems considered in this research are linear and time invariant. A synthesis procedure to obtain an optimum feedback system is given. Two independent transfer matrices are to be chosen. It is shown that the system stability in spite of plant parameter variations can be assured, and the system sensitivity and the effect of disturbances on the outputs due to the command signals can be minimized by the proper choice of one of the transfer matrices. The system performance index is minimized, and certain constraints on the plant inputs are satisfied by the optimum choice of both the transfer matrices. In the case of systems with deterministic inputs, a procedure to obtain an optimum interacting system is given. First, the system desired output vector is decomposed into subsystem desired output vectors. Then, each subsystem is synthesized so that the performance index of each subsystem is minimized. Author

N64-19401 Illinois U., Urbana Coordinated Science Lab.
ON NETWORKS AND BI-COMPLETE GRAPHS
James A. Resh Jul. 1963 66 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-174; AD-418172)

The following are discussed: (1) properties of terminal capacity matrices, (2) semicuts—pseudo bases, and μ-matrices, (3) bicircuit transformation of networks—bicircuits, and equivalent networks, and (4) realization of networks with specified terminal capacity matrices—maximum number of distinct entries, unique S-submatrices, and the general case. R.T.K.

N64-19403 Illinois U., Urbana Coordinated Science Lab.
A NEW APPROACH TO THE SENSITIVITY PROBLEM IN MULTIVARIABLE FEEDBACK SYSTEM DESIGN
J. B. Cruz, Jr. and W. R. Perkins Aug. 1963 13 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-177; AD-418175)

A new point of view for the parameter variation problem in linear multivariable systems is proposed. The output deviations due to parameter variations for an open-loop realization are related by a sensitivity matrix to the ouput deviations due to parameter variations for a closed-loop (feedback) realization. By means of a performance index involving this sensitivity matrix, conditions are obtained for insuring that the feedback realization is less affected by parameter variations than an open-loop realization having the same nominal transfer characteristics. A procedure based on this new sensitivity formulation is given for designing a multivariable feedback system. Author

N64-19405 Illinois U., Urbana Coordinated Science Lab.
THE PARAMETER VARIATION PROBLEM IN STATE FEEDBACK CONTROL SYSTEMS

W. R. Perkins and J. B. Cruz, Jr. Oct. 1963 26 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-182; AD-427077)

The plant parameter variation problem in multivariable linear systems described by state vector equations is formulated using a new sensitivity measure. This formulation involves a direct comparison of open-loop and state feedback performance in the presence of parameter variations, and provides a basis for guaranteeing the superiority of the feedback design. Results are obtained for both continuous and discrete multi-input multi-output systems. It is shown for single-input multi-output plants that a low sensitivity design is also an optimal feedback control design with respect to a quadratic performance index. Author

N64-19414 Aeronutronic, Newport Beach, Calif. Research Labs.
PROPELLANT OPTIMIZATION PROGRAM FOR COMPUTERS, MATHEMATICAL PROCEDURES, AND PROGRAMMING [Final Report]
E. R. Buley, D. G. Piper, B. Kubert, and L. Sashkin 14 Feb. 1964 40 p refs
(Contract AF 04(611)-8546)
(U-2502; RPL-TDR-64-35; AD-433734)

Modifications to an existing computer program are described. The resulting program can determine the composition yielding maximum impulse for multicomponent propellant mixtures subject to both equality and inequality constraints on the components. The program is coded for the IBM-7090 and 7094 computers and has been demonstrated for systems containing up to 8 components. The actual capability extends to 10 components. Also described are the mathematical formulation of the problem and procedures used for the optimization process with modifications. Instructions for using the program and program flow charts are included. Author

N64-19427 Massachusetts Inst. of Tech., Cambridge Lab. for Insulation Research
QUASI-PARTICLE LIFETIMES BY GREEN'S FUNCTION METHOD
James F. Janak *In its* Quasi-Particle Lifetimes by Green's Function Method Mar. 1964 18 p refs (See N64-19426 12-23)

Certain aspects of the Green's function method are reviewed in order to furnish the mathematical preliminaries for the quantum theory of domain-wall motion. The application of the Green's function method to the calculation of the response of systems of Bose particles to external fields, and to the calculation of the energies and lifetimes of the quantum states of the system is discussed. R.T.K.

N64-19493 European Organization for Nuclear Research, Geneva (Switzerland)
SCOPT, AN IBM 7090 CODE FOR BEAM OPTICS PROBLEMS ON THE SYNCHRO-CYCLOTRON
P. Skarek 18 Mar. 1964 24 p refs
(CERN-64-15)

This program (1404/03) was written in FORTRAN II for a 32-K IBM-7090 under monitor control. The program calculated charged particle trajectories in a synchro-cyclotron field and determined all beam properties needed for further matching and tracking through the layout by the TRAMP-Program. It is possible with the combined use of SCOPT and TRAMP to match and follow a beam beginning from an internal target, throughout the synchro-cyclotron stray field into the external layout. The integration routine is F. J. M. Farley's Mercury program 21 P 1^4 rewritten in FORTRAN. Many subroutines were added to adapt this program for use with the TRAMP-Program. SCOPT can also be used as a FORTRAN version of 21 P 1. Calculations for a nominal 70 Mev. π^+ beam are also presented. Author

N64-19549 Stanford U., Calif.
ON THE GAUSS CURVATURE OF NON-PARAMETRIC MINIMAL SURFACES
R. Finn and R. Osserman 20 Jan. 1964 20 p refs
(Grant DA-31-124-ARO(D)-170)
(AROD-1323-31; Tech. Rept. 28; AD-431060)

A minimal surface over a disk of radius is defined to clarify the gauss curvature of nonparametric minimal surfaces. A certain relation is shown. G.D.B.

N64-19587* California U., Berkeley Space Sciences Lab.
IMPROPER SOLUTIONS UNDER EXISTENCE ASSUMPTIONS: AN EXAMPLE
J. H. Eaton 19 Mar. 1964 14 p refs
(NASA Grant NsG-354)
(NASA CR-53837; *Its* Ser. 5, Issue 16) OTS: $1.60 ph

A pursuit problem is considered in which a pursuer X and target Y are points in an n-dimensional Euclidean space E^n. The pursuer is assumed to have knowledge of the control (and hence trajectory) to be used by the target and is to choose a control to minimize the time required to intercept the target. This minimum time is called the pursuit time. The target, wishing to delay interception as long as possible desires to choose a control that maximizes the pursuit time. It is shown that if the target assumes the existence of an optimal control (i.e., a control for which the least upper bound of the pursuit time is attained) he can be lead to a choice of control that will result in an interception in less time than if he applied no control at all. Author

N64-19616* American Inst. for Research, Los Angeles, Calif.
ARTIFICIAL INTELLIGENCE: A SUMMARY OF CURRENT RESEARCH AND DEVELOPMENT
Peter A. Lachenbruch, Alec J. Slivinske, and Angeline C. Marchese Feb. 1962 178 p refs
(NASA Contract NAS7-100; JPL Contract 950085)
(NASA CR-53830; AIR-C63-2/62-TR) OTS: $12.50 ph

Current research and development in the field of artificial intelligence was reviewed by examining existing physical, mathematical, and logical models of brain functions at the installations and facilities engaged in this research. Relevant literature also was reviewed to update the literature searches previously performed. The findings are summarized under the general headings of neurological considerations, special purpose computer models, and general computer program models. A bibliography of 1,129 supplementary specific references and 67 general sources (proceedings of symposia and conferences, anthologies and relevant bibliographies) is presented. A systematic review of the field is presented, with special emphasis on evaluating the potentiality of theory and of devices in providing a basis for the development of equipment to be used in space systems. Author

N64-19622* Arizona U., Tucson College of Engineering
RESEARCH IN AN APPLICATION OF MODERN AUTOMATIC CONTROL THEORY TO NUCLEAR ROCKET DYNAMICS AND CONTROL Semi-Annual Status Report No. 1, Jul. 1-Sep. 1, 1963

Lynn E. Weaver, Donald G. Schultz, David L. Hetrick, James L. Melsa, and Zoltan Rosztoczy Feb. 1964 57 p refs To be presented at the Am. Nucl. Soc. Meeting, Philadelphia, Jun. 1964
(NASA Grant NsG-490)
(NASA CR-53638) OTS: $5.60 ph

The first part of this report deals with the application of the Second Method of Liapunov to stability problems in nuclear reactors. Several examples related to the nuclear-rocket engine are given. The second part of the report is concerned with the application of Pontryagin's Maximum Principle to the solution of optimization problems in nuclear reactors. An optimum shutdown program is determined for reactors. This program will minimize the buildup of xenon poisoning after shutdown. Solution of this problem is felt to give insight into the problem of determining an optimum program for propellant release that will minimize the amount of propellant needed to accommodate the after-shutdown heat generation in nuclear-rocket engines. R.T.K.

N64-19630 Parke Mathematical Labs., Inc., Carlisle, Mass.
RESEARCH ON ALGEBRAIC AND STATISTICAL THEORY Final Report
L Calabi et al Feb. 1964 66 p refs
(Contract AF 19(604)-7493)
(Rept. 7493; AFCRL-64-139; AD-436275)

This report is divided into three parts: (1) the theory of Boolean formulas; (2) coding theory; and (3) varia, which includes a brief description of MADCAP—a multiple-precision floating-point basic arithmetic program for the PDP-1 computer. A.W.

N64-19657 Lockheed Missiles and Space Co., Palo Alto, Calif.
RESEARCH ON AUTOMATIC COMPUTER ELECTRONICS. VOLUME III, SYSTEM DESIGN RESEARCH Technical Documentary Report, 1 Sep. 1962-1 Oct. 1963
Richard I. Tanaka Wright-Patterson AFB, Ohio, Res. and Tech. Div., Feb. 1964 178 p refs
(Contract AF 33(657)-8777)
(RTD-TDR-63-4173, Vol. III; AD-435674)

This volume covers work on developing tools and techniques intended to lead to a rational integrated approach to the design of digital computer systems. A section on computer system design theory describes the steps followed in the overall design of a digital computer system, discusses the state of development of the techniques used in the various design steps, and proposes methods for advancing and automating some of the less undeveloped design steps. The results of a literature survey on heuristic programing are also included, as a preliminary effort to find heuristics that might be applicable to the systems design task. The problem of coding states in a combinational switching network is discussed. The relevancy of this problem to the system design task is first established, and then a number of new results are derived. In particular, a method of assigning states so as to reduce the complexity of the switching network under a wide variety of possible cost functions is presented. Author

N64-19658 General Dynamics/Astronautics, San Diego, Calif.
A USE OF DIGITAL COMPUTERS FOR ALGEBRAIC COMPUTATION
D. H. Jirauch and R. A. Westerwick Wright-Patterson AFB, Ohio, Res. and Tech. Div., Mar. 1964 130 p
(Contract AF 33(657)-10887)
(AE63-1079; RTD-TDR-63-4200; AD-437798)

Development studies were conducted to establish digital computer programs to develop a program that can derive equations of motion of systems in general terms (non-numeric). Studies were also made to develop a program to determine the relationship between the coefficients of a differential equation, which define the conditions necessary for periodic solutions. The mathematics of the methods are presented as well as the digital computer programs and instructions on how to use them. Examples illustrating program applications are given. Author

N64-19712 Atomics International, Canoga Park, Calif.
THE SNAPKIN VI COMPUTER PROGRAM FOR SNAP REACTOR KINETICS CALCULATIONS
W. A. Rhoades .[1964] 102 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9190) OTS: $2.25

A computer program is described that solves the space-independent reactor kinetics equations with feedback equations representing the principal shutdown mechanisms in a SNAP reactor. Reflector delay effects are treated by a "reflector group" model, which has been useful in application to KEWB, ZPR III, and other reactors. By using an alternate main program and two alternate subroutines, spatially dependent feedback effects may be considered. Printed, CRT, and punchcard output may be obtained optionally. Sample problems are demonstrated for both versions of the code. Author

N64-19714 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Sciences
GAPLSN, A MODIFIED DSN PROGRAM FOR THE SOLUTION OF THE ONE-DIMENSIONAL ANISOTROPIC TRANSPORT EQUATION
J. H. Alexander, G. W. Hinman, and J. R. Triplett 16 Mar. 1964 61 p refs
(GA-4972)

The GAPLSN is an extended version of DSN, a FLOCO-II program for solving one-dimensional neutron and photon transport problems. As originally written, DSN already provided a variety of coordinate systems, boundary conditions, and critical parameters, but accounted for, at most, two angular moments of the scattering cross section. In GAPLSN, however, the scattering cross section and also the external source may have anisotropy represented by an arbitrary number of angular moments. In addition, some geometrical data describing the integration paths are computed by GAPLSN, whereas in DSN they are specified by the problem input. The GAPLSN may be used with any version of the FLOCO-II system for the IBM 7090. Approximately 80% of the original DSN program remains unaltered in GAPLSN. A transport equation is described that is solved by converting the energy, direction, and position variables to discrete form and by evaluating the integrals and derivatives numerically. R.T.K.

N64-19748 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME QUESTIONS ABOUT THE STATISTICAL DYNAMICS OF AUTOMATIC REGULATORY SYSTEMS
Ye. I. Filippovich 11 Feb. 1964 18 p refs Transl. into ENGLISH from Avtomatiz. i Priborostr., Sb. Nauchn. Trudov, Gos. Izd. Tekhn. Lit. USSR (Kiev), no. 2, 1961 p 31-41 (FTD-TT-63-468/1+2+4; AD-433524)

A problem is solved that is a generalization of the problem of Zaden and Ragazzini in the theory of the synthesis of linear systems of automatic control. Along with the solution

of the formulated problem, methods are proposed that can be used when solving other analogous problems of the statistical theory of the synthesis of optimal systems. Author

N64-19774 California U., Berkeley Operations Research Center
REMOVING ARCS FROM A NETWORK
Richard Wollmer 13 Mar. 1964 18 p refs
(ORC 64-5(RR))

This report is a sensitivity analysis on a maximum flow network defined by a set of arcs and a set of points called nodes, one of which is designated as the source and another as the sink. The maximum amount of flow passing from source to sink may be calculated. Given a maximum flow network from which n arcs are to be removed, which n arcs, if removed, would reduce the flow to the greatest degree, and what would be this resulting maximum flow? An algorithm for solving such a problem is presented. A.W.

N64-19784 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF CONTINUOUS MODELS OF CONTROL SYSTEMS ON ELECTRONIC COMPUTER
I. P. Lukashevich *In its* Study of DNA Mol. Flexibility and Continuous Models of Excitable Media 20 Apr. 1964 p 11-20 refs (See N64-19782 12-01) OTS: $0.75

A mathematical model representing a discrete analog of an excitable homogeneous medium is described. The medium consists of identical elements connected identically with one another, i.e.: (1) Every point of the medium is capable of excitation that is instantaneous. (2) Excitation can spread in the medium. (3) Each point is capable of spontaneous activity. Results are discussed of a number of experiments in which the model was used. P.V.E.

N64-19860 California U., Berkeley
A BAYESIAN SOLUTION TO A SEQUENTIAL TWO-PERSON ZERO-SUM GAME
B. Gluss 6 Aug. 1963 14 p refs
(NSF Grant G-15965)

Two players are confronted with n machines that have known outcome probability distributions constant through time. They do not know, however, which machine is which. N trial pairs occur, each one of which comprises a play by each player on his selected machine. If Player 1 scores an amount x and Player 2 an amount y, then Player 2 pays Player 1 the difference x - y. The objective of the game is for both players to maximize their expected total discounted payoffs over the N trials. A general solution is found, and some examples are given, including the two-armed bandit problem. Author

N64-19867 University of Southern Calif., Los Angeles School of Engineering
ON DESIGN OF TIME OPTIMAL SPACE VEHICLE SYSTEMS VIA THE SECOND METHOD OF LYAPUNOV Interim Technical Documentary Report
Nasser E. Nahi Jan. 1964 20 p refs
(Contract AF 04(695)-304)
(USCEE-103; SSD-TDR-64-53; AD-429100)

Recently much attention has been given to synthesis of time optimal control systems, i.e., systems to be transferred from one state (such as a set of values for initial position, velocity, etc.) to a new state in minimum time while being operated from a limited source of power. In this report a class of systems has been introduced where a particular application of the second method of Lyapunov leads to a simple time-optimal feedback solution. A much broader class of systems has been identified in which a desired time of response can be achieved through the design of appropriate "dead-beat" systems. A number of examples are included to show the simplicity of the application of the suggested techniques to design of space vehicle systems and systems in general. Author

N64-19873 Stanford U., Calif. Solid-State Electronics Lab.
THE INFLUENCE OF COMPONENT IMPERFECTIONS ON TRAINABLE SYSTEM PERFORMANCE [Interim] Technical Report No. 4654-1 [Aug. 1961-Jun. 1963]
P. R. Low Oct. 1963 86 p refs
(Contract AF 33(616)-7726)
(SEL-63-078; RTD-TDR-63-4183; AD-429051) OTS: $8.10

This report considers the effect of such component defects as nonlinearity, nonuniformity, and hysteresis on the performance of trainable systems. The four areas of system performance considered are: the ability of the system to solve a given problem, the stability of the resulting solution, the generalizing ability of the system, and the time required to find a solution. A convergence proof is presented that shows that even a defective system will converge to a solution if one exists. An analytical technique called the "rate vector analysis" is developed that can be used to predict with reasonable accuracy the time required for a defective system to converge. When used on a 16-input system in which the weights have nonlinear adaption characteristics, the increase in training time due to the defect was predicted within 15 percent. Author

N64-19893 California U., Berkeley Electronics Research Lab.
ON SYSTEMS FOR AUTOMATIC CONTROL OF THE ROTATION OF A RIGID BODY
R. E. Mortensen 27 Nov. 1963 49 p refs
(NSF Grant 15965)
(Rept. 63-23)

Presented are a review of rigid-body dynamics and a formulation especially suitable for treatment by the techniques of Lyapunov and Pontryagin for studies of stability and optimization. From this formulation, based on quaternions, the Cayley-Rodriguez parameters are developed. These parameters permit the development of the complete dynamical equations for the control problem in a way to suggest a suitable control law for an automatic regulator. The Second Method of Lyapunov is used to prove that this regulator is asymptotically stable in the large. It is not claimed that the regulator is optimal in any sense. Rather, the purpose is to illustrate how the inherent structure of the dynamical equations plus some insight, based on the anticipated use of Lyapunov's test for stability, can suggest an a.s.i.l. control law. Finally, the actual problem of optimization, to which Pontryagin's principle may be applied, is surveyed briefly. Author

N64-19903 Joint Publications Research Service, Washington, D.C.
DIGITAL COMPUTER FOR TRAINING PURPOSES (ENC)
V. I. Matov, et al 6 May 1964 173 p Transl. into ENGLISH of the book "Uchebnaya Tsifrovaya Vychislitel'naya Mashina" Moscow, State Power Publishing House, 1963 p 1-128
(JPRS-24498; OTS-64-31219) OTS: $3.00

This book-length report contains eight chapters as follows: (1) arithmetical bases of ENC (educational numerical computer) construction; (2) elements of the ENC; (3) main ENC mechanisms; (4) memory device; (5) arithmetical mechanism; (6) control mechanism; (7) input and output devices; and (8) programing for the ENC. A.W.

N64-19924 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
ON THE APPLICATION OF AN APPROXIMATION TECHNIQUE TO THE PROBLEM OF OPTIMAL STABILIZATION OF NONLINEAR SYSTEMS
D. Boyanovitch Aug. 1963 16 p refs
(RN-165)

Liapunov's stability theory is used to construct a control law stabilizing an arbitrary nonlinear control system, so that a given integral criterion achieves a minimum value along the trajectory. A solution is reached by using either Galerkin's method or the method of characteristics, or a combination of the two. A.W.

N64-19928 Bureau Technique Zborowski, Brunoy (France)
THEORETICAL INVESTIGATION AND CONTROL BY MEASURING TESTS ON THE BEHAVIOR OF THE THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER ON AN ANNULAR WING AT VARIOUS INCIDENCES Final Report
Ernest A. Eichelbrenner, Serge Angioletti, Yves M. Grellier (Poitiers U.) and Rolf S. Hellerström 15 Sep. 1963 112 p refs
(Contract N-62558-3514)
(AD-428671)

Three complementary methods were used to determine experimentally the inner organization of separated areas: (1) visualization by ointment tests; (2) visualization with kerosene vapors; and (3) interpretation of constant pressure-ratio results. It was then relatively easy to calculate wall friction by integrated momentum and energy equations in longitudinal and transversal direction, thereby obtaining a knowledge of flow characteristics in three dimensions. A.W.

N64-19934 Adaptronics, Inc., Alexandria, Va.
THEORY OF PROBABILITY STATE VARIABLE SYSTEMS. VOLUME III: MONOTYPE SYSTEM THEORY AND CONSIDERATIONS FROM AUTOMATA THEORY Final Report, 15 Oct. 1961-14 Oct. 1962
L.O. Gilstrap, Jr., M. J. Pedelty, and R. J. Lee Wright-Patterson AFB, Ohio, AF Avionics Lab., Dec. 1963 148 p refs
(Contract AF 33(657)-7100)
(ASD-TDR-63-664, Vol. III; AD-428087)

The subject of probability-state variable systems was examined from two points of view. The first point of view is that of automata theory, and the problems of automaton environment interaction is discussed. Secondly, a detailed structural model of a generalized switching device was formulated, and the major problems of interest in the theory of monotype probability-state variable systems are described. Novel mathematical methods for determining properties of the probability state variable device were developed. An index notation for logic problems is presented, and some of the general properties of switching networks were analyzed using this notation. Author

N64-19940 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SEGMENTED RATIONAL MINMAX APPROXIMATION, CHARACTERISTIC PROPERTIES AND COMPUTATIONAL METHODS
Charles L. Lawson 19 Dec. 1963 22 p refs
(NASA Contract NAS7-100)
(NASA CR-53928; JPL-TR-32-579) OTS: $2.60 ph

Characterization theorems, solution procedures, and results of numerical examples are reported regarding the problem of partitioning an interval so that the largest error incurred in approximating a continuous function by separate polynomial or rational forms on each subinterval is minimized. Author

N64-19973 RAND Corp., Santa Monica, Calif.
NUMERICAL SOLUTION OF FUNCTIONAL EQUATIONS BY MEANS OF LAPLACE TRANSFORM—III: THE DIFFUSION EQUATION
R. E. Bellman, R. E. Kalaba, and J. Lockett Jan. 1964 19 p refs
(NIH Grant GM-09608-02)
(RM-3974-NIH; AD-428074)

A method for the numerical inversion of Laplace transforms was applied to the one-dimensional heat equation for an inhomogeneous medium. One advantage over the usual finite difference schemes is that a small amount of computation yields the solution for large values of the time. Author

N64-19986* Maryland U., College Park Inst. for Fluid Dynamics and Applied Mathematics
A GENERALIZED PERTURBATION EXPANSION FOR THE KLEIN-GORDON EQUATION WITH A SMALL NONLINEARITY
David Montgomery Mar. 1964 22 p refs
(NASA GRANT NsG-220-62)
(NASA CR-53502; BN-351) OTS: $2.60 ph

A previously given method for deriving uniformly valid perturbation series for the Klein-Gordon equation with a "small" nonlinear term is generalized to include situations in which the lowest order solution is not restricted to be a monochromatic wave. Author

N64-19995 Argonne National Lab., Ill.
FOIL ACTIVATION PROGRAMS, B512/RP
E. M. Pennington and W. L. Boettinger Jan. 1964 96 p refs
(Contract W-31-109-ENG-38)
(ANL-6822)

Programs have been written in FORTRAN for the IBM-704, which calculate cutoff-energy values and various activation integrals for foils in slab geometry. Both the absorbing foil and the covers are of arbitrary thicknesses, and have absorption cross sections consisting of a 1/v part and/or Breit-Wigner resonances. The angular dependence of the neutron flux is either isotropic or beam, whereas the energy dependence is either Maxwellian with several epithermal options or of a flux input for a suitable number of energy values. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-19410 Massachusetts Inst. of Tech., Cambridge
HEMISPHERIC WATER BALANCE FOR THE IGY Scientific Report No. 4
Victor P. Starr, Jose P. Peixoto, and Alfred R. Crisi 1 Dec. 1963 41 p refs
(Contract AF 19(628)-2408)
(AFCRL-63-928; AD-433130)

A study of various fields relating to water vapor and its flow over the Northern Hemisphere during the IGY, using the mean conditions for the calendar year 1958, is presented. The study includes analyses of the amount of precipitable water, of the vertically integrated water-vapor transport, and of the divergence of water-vapor transport for the hemisphere. Some implications

of the water-vapor divergence field are deduced that are important for hydrology and oceanography. The water-vapor balance is discussed in the light of various meteorological considerations. Author

N64-19429 Joint Publications Research Service, Washington, D.C.
ARTICLES ON METEOROLOGY AND HYDROLOGY
15 Apr. 1964 92 p refs Transl. into ENGLISH of 10 articles from Meteorol. i Gidrol. (Moscow), no. 2, Feb. 1964 p 3–40, 42–48, 56–61, and 63–64
(JPRS-24202; OTS-31083) OTS: $2.25

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8. STATISTICAL FORECASTS IN GEOPHYSICS (BOOK REVIEW) B. N. Belyayev, V. S. Bol'dyrev, and M. I. Fortus p 69–72 refs

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10. NEWS ITEMS OF INTEREST TO HYDROLOGISTS AND METEOROLOGISTS T. F. Bogdanova, V. N. Zakharov, L. M. Margolin, and V. D. Marushchenko p 85–88

N64-19430 Joint Publications Research Service, Washington, D.C.
ADIABATIC INVARIANTS OF THE ATMOSPHERIC PROCESSES
A. M. Obukhov *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 1–9 refs Presented at the Symp. on the Large-Scale Dyn. Processes in the Atmosphere, Boulder, Colo., Sep. 1963 (See N64-19429 12-21) OTS: $2.25

The problem of seeking the adiabatic invariants of atmospheric processes is discussed. The basic system of equations for the dynamics of the atmosphere, which satisfies the adiabatic approximation, is presented; the dynamic and thermodynamic adiabatic invariants (potential vortex and entropy) and the integral characteristics associated with them are discussed. R.T.K.

N64-19431 Joint Publications Research Service, Washington, D.C.
STATISTICAL METHODS OF WEATHER FORECASTING
N. A. Bagrov *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 10–23 (See N64-19429 12-21) OTS: $2.25

The topics discussed include: (1) dynamic and statistical laws; (2) the relation between dynamic and statistical approaches to weather forecasting; (3) methods of statistical forecasting—linear correlation analysis, and nonlinear forecasts; (4) forecasting of precipitation; (5) the instability of atmospheric processes; (6) methods of refining information; and (7) the accuracy of short- and long-range weather forecasts. R.T.K.

N64-19432 Joint Publications Research Service, Washington, D.C.
A METHOD OF CALCULATING THE MEAN VALUE OF H_{500} ON THE TENDENCY OF THE NATIONAL SYNOPTIC PERIOD
S. T. Pagava *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 24–33 refs (See N64-19429 12-21) OTS: $2.25

A description is given of a method of calculating, on the second day of the current natural synoptic period, the mean value of H_{500} for the tendency of the following natural synoptic period. An experimental check on weather forecasts made by using this method indicates the validity of the method, particularly when the convective heat flow in the atmosphere is taken into consideration. R.T.K.

N64-19433 Joint Publications Research Service, Washington, D.C.
AN INVESTIGATION OF THE ANOMALOUS SHORT-PERIOD OSCILLATIONS OF CYCLONIC AND ANTICYCLONIC ACTIVITY
N. A. Belinskiy and M. G. Glagoleva *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 34–40 refs (See N64-19429 12-21) OTS: $2.25

In an effort to study cyclic oscillations by a strict, quantitative method, the 5-day anomalies of cyclonic or anticyclonic activity, in the time period from 1944 to 1959, were investigated. The anomalies were selected in a space limited by latitude 35° to 80° N and longitude 40° to 70° E. A detailed quantitative study of these anomalies demonstrates that the rhythmic or cyclic oscillations, widely used in long-range forecasting, actually do occur in the course of the atmospheric processes. However, the periods of the cyclic oscillations are unstable. This instability limits their usefulness; it is caused by brief variations in solar activity. At the present time, it is not possible to predict changes in atmospheric processes due to changes in solar activity. R.T.K.

N64-19434 Joint Publications Research Service, Washington, D.C.
OBJECTIVE FORECASTING OF MEAN VALUES OF H_{500} OF A SYNOPTIC PERIOD
A. L. Kats, V. I. Knyazeva, and A. I. Tokunova *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 41–48 refs (See N64-19429 12-21) OTS: $2.25

A method is presented for producing maps that forecast the mean values of H_{500} for the current synoptic period as well as for maps that forecast the changes in H_{500} for the following synoptic period. The method is based on the use of empirical effect functions. The calculation of the empirical effect functions is performed separately for different forms and states of the circulation and is determined by means of zonality and meridionality indices. The method uses the values of H_{500} and the changes in H^{500}_{1000} at a number of points of a limited so-called synoptic region along with the state of the circulation in other regions of the hemisphere that are characterized by zonality indices and meridionality indices. P.V.E.

N64-19435 Joint Publications Research Service, Washington, D.C.
ANALYSIS OF PECULIARITIES OF ZONAL CIRCULATION
N. I. Zverev *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 49–55 refs (See N64-19429 12-21) OTS: $2.25

An investigation of whether there are any noticeable cycles in the time sequence of the circulation indices is discussed. Initially, all the circulation indices, separately by seasons, were divided into two groups. The first group included indices $I_i > \Gamma$, where Γ signifies the mean value of the zonality index for the particular month of the season, and all other indices $I_i \leq \Gamma$ were included in the second group. As a result of the selection of indices, the atmospheric macroprocesses were divided into two types—intensive and weakened transfer of air from the west to the east. It was found in the atmospheric motion in the entire Northern Hemisphere that there is a tendency toward a preservation of the initial state. From the appearance of the transitional probability matrices developed, it is found that in the oscillations of the circulation index relative to its mean value there originate, occasionally, closed cycles that rapidly disappear. From the developed matrices, a synoptic conclusion is drawn—the greater the index of zonal air transfer deviates from its mean value, the more stable it is in time. P.V.E.

N64-19436 Joint Publications Research Service, Washington, D.C.
SOME QUESTIONS ON THE SYNOPTIC METHOD OF LONG-RANGE WEATHER FORECASTING
Z. L. Turketti *In its* Articles on Meteorology and Hydrol. 15 Apr. 1964 p 56–68 refs (See N64-19429 12-21) OTS: $2.25

A discussion is presented of the various factors that enter into making long-range weather forecasts. P.V.E.

N64-19582* Astropower, Inc., Newport Beach, Calif. Electronics Lab.
CLOUD PATTERN INTERPRETATION [Final Report]
R. D. Joseph, S. S. Viglione, and H. F. Wolf Aug. 1963 118 p refs
(NASA Contract NASw-609)
(NASA CR-53778; Rept. 129-F) OTS: $9.60 ph

Using actual Tiros films and an optical correlation procedure, the feasibility of using a self-organized, parallel logic system to recognize cloud structures indicative of storms was investigated. The films were a sampling of cloud formations available from data supplied by Tiros. These data were standardized to remove variations due to film type and processing technique, and to concentrate on the cloud structure. The optical-correlation measurement was taken and analyzed by a computer. Equations were used of "forced learning" perceptron analysis to estimate the number of logic units required in the parallel logic layer to achieve a specified recognition performance level. Computer results showed that due to the intermixing of the pattern classes, caused partly by optical measuring inaccuracy and partly by the pattern complexity, the forced learning perceptron analysis achieves only a limited effectiveness of recognition (65 to 70%). The required logic layer to asymptotically approach this performance level consists of 50 logic units; more logic units do not improve system performance. Increasing the effectiveness of the decision process by implementing a closed-loop learning routine (iterative design) is discussed. Author

N64-19604* Chicago U., Ill.
SYNOPTIC INTERPRETATION OF TIROS III MEASUREMENTS OF INFRARED RADIATION
Finn Pedersen and Tetsuya Fujita Oct. 1963 45 p refs
(NASA Grant NsG-333; Mesometeorology Proj.; Grant Cwb WBG-6)
(NASA CR-53851; Res. Paper 19) OTS: $4.60

Infrared radiation measurements in Channels 2 and 4 for R/O 142 and 143 are used for this study. The effects of large zenith angles of the radiometer axis on the recorded radiation patterns are discussed and illustrated by means of examples. The method of Wark, Yamamoto, and Lienesch for computing outgoing total infrared flux by means of Channel 4 measurements is further developed and given a form more suitable for work on maps. This method is tested by applying it to the initial and complemental scans of the same general area in which the measurements are separated by a time interval of only a few minutes. The method is found to give reasonable and consistent mean values for areas, each of which covers about 0.2 percent of the area of the total surface of the earth. Author

N64-19607* Geophysics Corp. of America, Bedford, Mass.
AN EXPERIMENTALLY DETERMINED MODEL FOR THE PERIODIC CHARACTER OF WINDS FROM 85 TO 135 KM
E. Manring, J. Bedinger, H. Knaflich, and D. Layzer Nov. 1963 115 p refs
(NASA Contract NASw-712)
(NASA CR-53666; GCA-TR-63-27-N) OTS: $9.60 ph

Measurements of upper atmospheric winds were made at Wallops Island, Virginia, using the sodium vapor technique. To date, measurements from 22 different vapor trails have been analyzed. In the 85- to 135-km region, the measurements show a relation that is cyclic with time. The data were analyzed in terms of cyclic components during 24-hour, 12-hour, and 8-hour periods. A new picture of the wind structure at these altitudes is proposed. Author

N64-19610* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INFERENCES OF STRATOSPHERIC AND MESOSPHERIC CIRCULATION SYSTEMS FROM ROCKET EXPERIMENTS
G. Warnecke and W. Nordberg Jan. 1964 30 p refs
(NASA TM X-51597; X-651-64-22) OTS: $2.60 ph

Recent rocket-grenade experimental results are interpreted to show the existence and movement of conventional circulation systems throughout the upper stratosphere and mesosphere. The evidence reveals that moving-pressure systems exist up to an altitude of 70 km, where the nature of the circulation changes abruptly. The pattern of the pressure systems in the stratosphere (below 50 km) seems to be different from the pattern inferred at higher altitudes (50 to 70 km). Author

N64-19671 Oklahoma U. Research Inst., Norman
SOME CHARACTERISTICS OF DENSITY DISTRIBUTION AS INFERRED FROM WIND MEASUREMENTS MADE BY THE METEOROLOGICAL ROCKET NETWORK Scientific Report No. 2
Donald Ray Thornley Feb. 1964 54 p refs
(Contract AF 19(628)-489)
(AFCRL-64-124; ARI-1357-2; AD-437135)

Wind observations from the Meteorological Rocket Network are applied to the investigation of the distribution of density, and the relationship between the distribution of density and the distributions of temperature and pressure to 65-km altitude. Results are analyzed physically and statistically. These wind data depict the known features of the density

field and suggest that a hitherto unsuspected region of temperature control exists between an altitude of 20 and 33 km. Author

N64-19739 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADAR METHODS OF METEOROLOGICAL OBSERVATIONS
V. S. Nelepets and V. D. Stepanenko 11 Apr. 1963 224 p refs Transl. into ENGLISH of a book "Radiolokatsionnye Metody Meteorologicheskikh Nablyudeniy", Leningrad, Gidrometeorol. Izd., 1961 220 p refs
(FTD-TT-62-1423/1+2; AD-402599)

The book deals with the use of radar methods in meteorology, some general problems in radar, the theory of radar sounding of atmospheric formations, and many practical problems in this field. Author

N64-19895 Weather Bureau, Washington, D.C.
DAILY 100-MILLIBAR AND 50-MILLIBAR AND THREE TIMES MONTHLY 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE IGC PERIOD, MAY 1959
Ralph B. Mason, Calvin E. Anderson, D. John Coparanis, and Dale A. Lowry Jun. 1963 74 p refs Sponsored by AEC, NSF, and Bur. of Naval Weapons

This series of analyzed charts for constant pressure surfaces at stratospheric levels is a continuation of the International Geophysical Year series and includes the first 6 months of the International Geophysical Cooperation. The principal source of upper-air observations for the charts is the microcard set of the World Meteorological Organization, Form No. 3 (radiosonde and rawinsonde observations) and Form No. 4 (upper-wind observations). These are microphotographs of original forms containing data checked by the individual countries of the world. When convenient, the original forms themselves, machine tabulations, photocopies, or microfilm copies were used. The plotting models and the extrapolation techniques used are described. R.T.K.

N64-19896 Weather Bureau, Washington, D.C.
DAILY 100-MILLIBAR AND 50-MILLIBAR AND THREE TIMES MONTHLY 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE IGC PERIOD, JUNE 1959
Ralph B. Mason, Calvin E. Anderson, D. John Coparanis, and Dale A. Lowry Jun. 1963 74 p refs Sponsored by AEC, NSF, and Bur. of Naval Weapons

This series of analyzed charts of the Northern Hemisphere for constant pressure surfaces was issued monthly for the period July 1957 through June 1959. R.L.K.

N64-19930 Chicago U., Ill.
USE OF TIROS PICTURES FOR STUDIES OF THE INTERNAL STRUCTURE OF TROPICAL STORMS
Tetsuya Fujita Oct. 1963 28 p refs
(Grant CWB-WBG-6)
(Res. Paper 25; AD-428165)

A series of Tiros I pictures of the South Pacific tropical storm of 10 April 1960, rectified with great accuracy, was used to study the fine structure of the storm. Three orientations of clouds-in-line were examined to find their causes. The first orientation represents the direction of the low-level winds along which small cumuli align as a cloud street. The second corresponds to the hurricane rainband and represents a streak line when large convective towers originate at a fixed source on the earth. The plumes of cirrus from high convective towers appear as the third orientation. A theoretical study leading to the determination of cloud height from shadow on the ocean surface was also made. It is feasible to identify shadows if clouds are located over an area of ocean sun glint. Author

N64-19932 Polytechnic Inst. of Brooklyn, N.Y.
VORTICAL CLOUD PATTERNS ON THE LEEWARD SIDE OF ISLANDS Final Report
Lu Ting Nov. 1963 20 p refs
(Grant WBG-12)
(PIBAL-818; AD-428025)

A theoretical analysis was conducted of the vortical-cloud patterns on the leeward side of islands recently observed by Tiros satellites. The disturbance created by a flat island will be replaced by that of a horseshoe vortex and its image. The deflection of the trailing vortex lines is obtained explicitly. The location of the observed vortex-like cloud is then interpreted as the intersection of the deflected trailing vortex line with the inversion level. Another theory on the vortex cloud patterns is also presented, together with its shortcomings. An outline of the procedure of the analytical solution of the lifetime of a viscous vortex in a nonuniform stream is presented. Author

N64-19936 Travelers Research Center, Inc., Hartford, Conn.
THEORETICAL AND SYNOPTIC STUDIES OF LOW-LEVEL TROPICAL PERTURBATIONS Final Report
Geirmundur Árnason, Keith D. Hage, and George M. Howe Oct. 1963 91 p refs
(Contract Cwb-10499)
(Rept. 7051-97; AD-428604)

The theoretical part of this study deals with the effect of a variable Coriolis parameter on the propagation and growth of small perturbations in a uniformly moving, statically unstable atmosphere and with the stability properties of small perturbations in a statically unstable baroclinic zonal flow. A variable Coriolis parameter results in (1) speeds of propagation that, depending on static stability and latitude, may be either westward or eastward relative to the basic flow and (2) an increase in scale of marginally unstable perturbations. The synoptic part of this study, still incomplete, deals with a modestly intense low-level perturbation. Tentative results show it to be embedded in a conditionally unstable, slightly baroclinic easterly flow, to have a wavelength of about 1,600 km, and to be moving faster than the flow in which it is embedded. Author

N64-19967 Weather Bureau, Washington, D.C. Meteorological Satellite Lab.
THE USE OF SATELLITE CLOUD PHOTOGRAPHS IN NUMERICAL WEATHER PREDICTION
Mary Ann Ruzecki Dec. 1963 27 p refs
(MSL-23; AD-428269)

Tiros cloud photographs and nephanalyses were used to modify, in sparse data areas, the stream function field that had been objectively analyzed. The modified analysis is used in numerical prediction models to compute new height prognoses. These forecasts are then tested to see whether an improvement has been made. To produce the reanalysis, a combination of NWSC and NWP computer codes was used. A.W.

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-19809 Civil Aeronautics Board, Washington, D.C.
NORTHWEST AIRLINES, INC., DOUGLAS DC-7C, N 290, ANNETTE ISLAND, ALASKA, JUNE 3, 1963. AIRCRAFT ACCIDENT REPORT
Alan S. Boyd et al 21 Apr. 1964 11 p

The aircraft had been airborne approximately 2 hr and 35 min when radio contact was lost. No difficulties were reported by the crew prior to this time. The wreckage was sighted by a Royal Canadian Air Force aircraft at 0322 G.m.t., June 4, 1963, at 54° 21'N–134° 39'W, but no survivors were observed. Approximately 1,500 lb of floating aircraft wreckage were recovered. Because of a lack of evidence the Board was unable to determine the probable cause of this accident. Author

N64-19813 Mitre Corp., Bedford, Mass.
A CRITICAL SURVEY OF IN-ORBIT GUIDANCE AND CONTROL PROBLEMS AND A FUNCTIONAL ANALYSIS OF A MASTER CONTROL CENTER
K. K. Maitra and G. A. Bakalyar Bedford, Mass., Electronics Systems Div., Dec. 1963 45 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-63-482; W-6374; AD-428743)

The in-orbit guidance and attitude control of space vehicles is discussed. Orbital transfer, rendezvous, interception, orbit sustaining, attitude control, and corrective guidance are discussed in a qualitative fashion. The significance of mass and/or time-optimized guidance subject to boundedness of thrust magnitude, attitude, and phase constraints is emphasized. Precise mathematical formulations within the frameworks of the variational calculus followed by a brief critical survey of the available optimization techniques relevant to the above problems are also contained in this document. The state-of-the-art and the available "unclassified" results are briefly reviewed. An analysis of the functional requirements of a "control center" relevant to in-orbit guidance is given. Author

N64-19857 Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.
FLIGHT DATA SYSTEM SPECIAL MODE STUDIES
G. P. Zemlin and L. Mc Gann Oct. 1963 55 p
(Contract AF 33(616)-6579)
(SMFD-2-2; AD-429035)

The analysis of the geometric relationships of the inertial platform gimbal system includes a set of transformations between gimbal angles, vehicle body rates, and vehicle attitude angles to provide a basis for gimbal output error analysis. The steady-state response characteristics of the outer roll gimbal, while operating under special mode conditions, are studied in the LN-4 platform outer-roll gimbal response analysis. A replacement for the normal signal adaptor in vehicles or for missions requiring special mode operation is described in an analysis of the mechanization of the LN-4 special mode controller. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-19308* General Electric Co., Philadelphia, Pa. Valley Forge Space Technology Center
9 1/2-FOOT DIAMETER MASTER AND MIRROR Final Report
J. J. Guy 20 Mar. 1964 221 p refs
(NASA Contract NAS7-100; JPL Contract 950239)
(NASA CR-53813; Rept. 64SD540) OTS: $15.00 ph

Phase I of this program consisted of providing a high-quality spincasting that could be electroformed. After the 10th pour of resin, this phase was successfully completed. It was then necessary to proceed to the electroforming phase, which was divided into two parts: (1) fabrication of the nickel male master; and (2) fabrication of the female mirror. The major difficulty in obtaining optical quality reproduction in the electroforming of the male master was solved with the development of an order-of-magnitude more accurate stress-measuring device. The electroforming of the female mirror presented few problems. A.W.

N64-19362 Thompson Ramo Wooldridge, Canoga Park, Calif. Space Technology Labs.
LOW ENERGY RADIATION DAMAGE TO SURFACES
R. L. Hammel *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 65–77 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

Results are discussed of initial experiments to determine the synergistic effect produced on selected materials when subjected to a simultaneous exposure to ultraviolet and low-energy electron radiation in a laboratory vacuum. The materials tested in the investigation were 304 stainless steel, 5557 soft anodized aluminum, glass, and a white-pigmented silicate base paint. Three primary irradiations were performed (electron, ultraviolet, and electron-ultraviolet exposures) in which all four materials were exposed simultaneously to identical conditions. A slight-to-moderate increase in absorptance was produced by the ultraviolet exposure, with the exception of the 5557 anodized that showed no change. The electron exposure produced a notable change in all materials, whereas the simultaneous electron-ultraviolet exposure in all cases produced the greatest change. The silicate paint and glass that have the lowest initial absorptance show the greatest percentage change. The effect of simultaneous electron and ultraviolet exposures was in all cases significantly greater than the sum of the individual changes, with the exception of the stainless steel. P.V.E.

N64-19363 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
HYPERVELOCITY IMPACT STUDIES CONCERNING THE METEOROID HAZARD TO AEROSPACE MATERIALS AND STRUCTURES
J. Wm. Gehring, D. R. Christman, and A. R. Mc Millan *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 78–91 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

The simulation of meteoroid or fragment impacts in the laboratory is discussed. It is concluded that detailed experimental studies of hypervelocity-impact phenomena and their effects on aerospace materials and structures can be carried out with available particle-projection techniques. It is also concluded that although it is apparent that there is a general understanding of basic target behavior, there is a decided lack of detailed knowledge concerning such specific areas as: (1) the influence of variables such as strengths, density, wave velocity, crystal structure, and anisotropy on cratering in semi-infinite targets and perforation of thin targets; (2) projectile behavior after perforating a thin target, including the fragmentation of the projectile and the distribution of fragments in terms of mass, velocity, and direction; and (3) high-strain-rate properties of materials, including shock-wave propagation and attenuation. P.V.E.

N64-19372* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE RESISTANCE OF A VARIETY OF COMPOSITE SPACE STRUCTURES TO HYPERVELOCITY IMPACT
James L. Summers and C. Robert Nysmith *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 386–393 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

Small glass spheres, representative of stoney meteoroids, were fired at velocities from 20,000 to 23,000 fps into a variety of composite structures. In general, the structures were composed of two or three sheets of 2024-T3 aluminum alloy separated by layers of low-density fillers of polyurethane foam, polystyrene foam, and glass wool, as well as structural elements of aluminum honeycomb and rigid cellulose foam (artificial sponge). Ablative heat shields bonded to stainless-steel structures were also tested. Many target configurations were tested at −150° F in order to demonstrate the effect of target embrittlement resulting from low temperature, and one target was tested at an angle of obliquity of 45° in order to illustrate a subtle weakness. Author

N64-19374 Army Signal Research and Development Lab., Fort Monmouth, N.J.
DENSITY DISTRIBUTION IN THE NORTHERN HEMISPHERE
Irving B. Chernetz Oct. 1963 60 p refs
(USAELRDL-TR-2393; AD-425913)

Using Weather Bureau data, charts were drawn that illustrate the distribution of the mean air-density values over the Northern Hemisphere for winter and summer, as well as the distribution of one standard deviation of these mean density values for the same periods. Also included are air-density profiles for various stations, showing the percent deviations from the 1959 ARDC model atmosphere of the mean and the $\pm 3\sigma$ values of the air density. Author

N64-19375 Army Signal Research and Development Lab., Fort Monmouth, N.J.
ON THE THEORY OF THE ATMOSPHERIC ELECTRIC CURRENT FLOW, IV
Heinz W. Kasemir Oct. 1963 26 p refs
(USAELRDL-TR-2394; AD-423619)

Starting from the differential equation of the continuity of the current flow, a general solution is given for problems in which the conductivity is given as a function of space and time. A physical interpretation for the complete Maxwell current is obtained, and it is shown how the Maxwell current can be composed of two field vectors, namely, that of the electrostatic field and of the stationary current flow. Each vector is weighted by a different time function, which can be calculated from the time function of the current source. A method is developed for the calculation of the stationary current flow field; the eigen functions for cartesian, cylindrical, and polar coordinates are given. Author

N64-19386 Radio Corp. of America, Princeton, N.J. Special Electronic Components Div.
SUPERCONDUCTING MAGNETS
N. S. Freedman *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 36–39 refs (See N64-19376 12-06)

Superconductivity allows the design of very-high-field magnets that can be started by low-voltage storage batteries and then operated with little or no further current input because of the zero loss in the windings. The process discussed for producing niobium-tin ribbon results in a unique, practical superconductor. Modular designs using this ribbon have an excellent chance of providing breakthroughs in the technology of large superconducting magnets. Author

N64-19394 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
NUCLEAR MEASUREMENT TECHNIQUES FOR RADIATION-EFFECTS ENVIRONMENTAL TESTING
W. E. Dungan and J. H. Lewis 31 Mar. 1962 110 p refs
(Contract AF 33(657)-7201)
(NARF-62-4T; FZK-9-175; AD-275155)

The methods and techniques for characterizing radiation-effects environments are discussed. Procedures for dosimetry planning and execution, together with detailed examples for specific application, are included. Included also are reaction data, calibration factors, and flux calculations for thermal-, resonance-, and fast-neutron foil-type detectors. Several figures illustrate typical neutron spectra and integrals, gamma spectra, decay schemes, statistical analysis of data, pulse shapes, and nonnuclear (temperature) parametric effects on gamma systems. Decay schemes of some useful neutron detectors and detailed procedures for IBM reduction of foil data are presented. Author

N64-19409 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
ON THE DISPERSAL OF ACOUSTIC WAVES BY RADIATIVE TRANSFER OF HEAT
F. K. Moore Apr. 1964 44 p refs
(Contract Nonr-2653(00))
(CAL-AF-1285-A-11; AD-437339)

It is shown that the assumption of a specific heat ratio near one simplifies the analysis of plane sound waves subject to energy addition dependent on temperature. In the case of radiative energy exchange in a fairly transparent gas, a third-order differential equation is obtained. Solutions are presented for an impulsively moved piston. In a very hot gas, an optically thin wave, dispersing as though by relaxation, is embedded in an optically thick wave dispersing as though by conduction. The cool-gas case is also analyzed. It is concluded that only in a very hot gas would dispersion be observed terrestrially. Author

N64-19418 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDIES IN AUTOMATIC PATTERN RECOGNITION Final Report
Thomas Marill et al 31 Oct. 1963 34 p refs
(Contract AF 19(628)-227)
(AFCRL-63-792, Rept. 1070; AD-434824)

CONTENTS:

1. ON THE EFFECTIVENESS OF RECEPTORS IN RECOGNITION SYSTEMS T. Marill and D. M. Green 8 p refs (See N64-19419 12-23)

2. CYCLOPS-1: A SECOND-GENERATION RECOGNITION SYSTEM T. Marill, A. K. Hartley, T. G. Evans, B. H. Bloom, D. M. R. Park, et al p 1–15 refs (See N64-19420 12-23)

N64-19419 Bolt, Beranek, and Newman, Inc., Cambridge Mass.

ON THE EFFECTIVENESS OF RECEPTORS IN RECOGNITION SYSTEMS

T. Marill and D. M. Green *In its* Studies in Autom. Pattern Recognition 31 Oct. 1963 8 p refs Repr. from IEEE Trans. Profess. Group Inform. Theory, v. IT-9, no. 1, Jan. 1963 (See N64-19418 12-23)

(Contract AF 19(604)-6632)

In the type of recognition system discussed, the physical sample to be recognized is first subjected to a battery of tests; on the basis of the test results, the sample is then assigned to one of a number of prespecified categories. The effectiveness of a set of tests is measured empirically, i.e., by determining the percentage of correct recognitions made by some recognition device that uses these tests. Discussed are some of the theoretical problems encountered in trying to determine a more formal measure of the effectiveness of a set of tests, a measure that might be a practical substitute for the empirical evaluation. Specific suggestions are considered for the case in which the test results are normally distributed, but arbitrarily correlated. The discussion is supported by the results of experiments dealing with automatic recognition of hand-printed characters. Author

N64-19420 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

CYCLOPS-1: A SECOND-GENERATION RECOGNITION SYSTEM

T. Marill, A. K. Hartley, T. G. Evans, B. H. Bloom, D. M. R. Park et al *In its* Studies in Autom. Pattern Recognition 31 Oct. 1963 p 1–15 refs Presented at AFIPS Fall Joint Computer Conf., Las Vegas, 12 Nov. 1963 Submitted for Publication (See N64-19418 12-23)

Cyclops-1 is a working recognition system with the following capabilities: (1) The system can recognize all hand-printed alphabetic and numeric characters; there are virtually no restrictions on the manner in which the characters may be printed. (2) The system can analyze complex visual inputs consisting of an arbitrary number of characters present simultaneously; the characters may be of different sizes and orientations; they may overlap, or be inside of one another; they may be superimposed on arbitrary backgrounds consisting of meaningless lines or spots or geometric shapes. (3) The repertoire of items recognized by the system may readily be enlarged to include shapes other than alphabetic or numeric characters. New items may be added without affecting the recognition of those already in the repertoire. Author

N64-19426 Massachusetts Inst. of Tech., Cambridge Lab. for Insulation Research

QUASI-PARTICLE LIFETIMES BY GREEN'S FUNCTION METHOD. QUANTUM THEORY OF DOMAIN-WALL MOTION

James F. Janak Mar. 1964 51 p refs

(Contract Nonr-1841(10))

(Tech. Repts. 186 and 187; AD-435902)

CONTENTS:

1. QUASI-PARTICLE LIFETIMES BY GREEN'S FUNCTION METHOD James F. Janak 18 p refs (See N64-19427 12-20)

2. QUANTUM THEORY OF DOMAIN-WALL MOTION James F. Janak 29 p refs (See N64-19428 12-23)

N64-19428 Massachusetts Inst. of Tech., Cambridge Lab. for Insulation Research

QUANTUM THEORY OF DOMAIN-WALL MOTION

James F. Janak *In its* Quasi-Particle Lifetimes by Green's Function Method Mar. 1964 29 p refs (See N64-19426 12-23)

The object of this report is to set up an analogous description of the problem of domain-wall (DW) motion, and to obtain therefrom the first explicit calculation of the DW damping parameter in terms of fundamental quantities. By deriving the loss terms from first principles, the question of which type of loss term is best used in describing DW motion was determined; for the assumption made, by the Bloch–Bloembergen form is correct; the motion is not describable by the Landau–Lifshitz equation. The low-lying excitations of the spin system are found over a ground state consisting of some sort of DW structure. The theory of DW motion led to three results: (1) The bound DW contributes a linear term to the specific heat of the ferromagnet. (2) For intrinsic spin-spin interactions, the energy dispersion of the uniform translation is proportional to T^2. (3) The dispersion of the uniform translation due to internal fluctuations is nearly equal to the dispersion of the uniform precession in ferromagnetic resonance. R.T.K.

N64-19459 Joint Publications Research Service, Washington, D.C.

PROBLEM OF THE ORIGIN OF ELEMENTS

P. G. Parkhomenko *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 166–176 refs (See N64-19451 12-05) OTS: $4.00

The most recent values for the nuclear bonding energy were used to verify the validity of the theory of equilibrium origin of the elements. The ordinary equation of thermonuclear equilibrium was used, leading to a linear dependence between the logarithm of the relationship of two cosmic distributions with the difference of the corresponding bonding energies. The equilibrium lines have been obtained precisely determined by empirical data. The polyneutron theory of Mayer and Teller is not confirmed by numerical data. The neutron theory of Alpher and Herman yields a curve averaging the Brown data, but it cannot explain and predict the comparative distributions of isotopes. Author

N64-19460 Joint Publications Research Service, Washington, D.C.

MAINTENANCE OF EQUILIBRIUM DISTRIBUTIONS FOR INTERMEDIATE ATOMS

P. G. Parkhomenko *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 177–180 refs (See N64-19451 12-05) OTS: $4.00

Based on mass values recently published for isotopes in the group of atoms from Z = 31 to Z = 41, equilibrium lines were plotted and the equilibrium temperature and neutron concentration values found. Comparison with the results of the previous work revealed a monotonic drop in the freezing point with increase in atomic weight. A drop was found in the corresponding neutron concentration with increase in A. Author

N64-19475 Nihon U., Tokyo (Japan)
MASS SPECTRA OF PARTICLES AND THE MODELS OF THE STRONG INTERACTIONS
Seitaro Nakamura [1964] 47 p refs
(NUP-64-1)

By introducing a new vector $\vec{U}$, the third component U_3 of which is put equal to hypercharge, a mass formula of baryons is introduced: $M = M_0 + \alpha F(U, U_3)$; $F(U, U_3) = U(U + 1)/2 - 3U_3 - U_3^2 - 1$; $M_0 = M_{\Sigma 0}$; $\alpha = 31.36$ Mev. Assigned is a triplet $U = 1$ consisting of nucleon ($U_3 = +1$), Σ-hyperon ($U_3 = 0$), and Ξ-hyperon ($U_3 = -1$), and a singlet $U = 0$ consisting of Λ-hyperon. A possible interpretation is given to this mass formula in terms of the strong interactions with meson fields with the supposed higher symmetry, which is in turn broken because the original multiplets of baryons are arranged in the scheme where a half of the full positions is unoccupied. The possible existence of a group of the super heavy fermions is conjectured, which may occupy the remaining half. A brief account is also given to the mass formula of mesons. Author

N64-19476 European Organization for Nuclear Research, Geneva (Switzerland)
HIGH-ENERGY NUCLEAR REACTION CROSS-SECTIONS. III
E. Bruninx 18 Mar. 1964 122 p refs
(CERN-64-17)

This report contains cross-section data based on newly adopted values for the cross sections of the monitor reactions ^{27}Al (p,3pn)^{24}Na, and ^{12}C (p,pn)^{11}C. A.W.

N64-19482 Boeing Co., Seattle, Wash.
ELECTRON SHIELDING CODES FOR EVALUATION OF SPACE RADIATION HAZARDS
B. W. Mar [1963] 31 p refs
(D2-90414)

A Monte Carlo code has been developed to compute high-energy electron penetration (0.1 to 10 Mev). The results of this code (range, backscatter, and transmission) have been verified with theoretical and experimental data. Based on Monte Carlo results, an expression for number transmission has been derived as a function of incident electron energy, shield thickness, and shield atomic number. This expression was incorporated into a vehicle analysis code that computes the dose in a vehicle from incident electrons. Data are presented for the transmission of monoenergetic electrons in Be, Al, Fe, and Ag, of a fission spectrum, and of Van Allen spectrum electrons in aluminum. The results of a vehicle analysis are also shown. Author

N64-19484 California U., Berkeley. Lawrence Radiation Lab.
CONTROLLED THERMONUCLEAR RESEARCH SEMIANNUAL REPORT, JULY-DECEMBER 1963
30 Jan. 1964 107 p refs
(Contract W-7405-ENG-48)
(UCRL-11172) OTS: $2.25

This report includes discussions of the following: (1) the pyrotron or magnetic-mirror program; (2) the Astron program; (3) the Livermore pinch program; (4) theoretical and basic experimental plasma physics; and (5) engineering and technological development in thermonuclear research. A.W.

N64-19486 Rochester U., N.Y.
PREDICTION OF A π^β RESONANCE
J. Schechter and S. Okubo 7 Apr. 1964 22 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-5)

Using the bootstrap approximation of Zachariasen and Zemach, a relatively broad 1^- resonance at about 1 Bev is predicted in a two-channel ($\pi\eta$, $\pi\rho$) calculation. Such a resonance can only belong to the isosuplet representation of SU(3). Tentatively, an identification can be made on this basis with the B meson and with a recently observed peaking in the $\pi\rho$ channel at about 1,250 Mev. Author

N64-19487 Rochester U., N.Y.
DECAY MODE $K \rightarrow 2\pi + \gamma$
Stephen V. Pepper and Yoshiaki Ueda 6 Apr. 1964 36 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-30)

The radiative decay $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ is considered in the light of the $\Delta T + 1/2$ rule. The possibility that the nonradiative and radiative rates are of the same order of magnitude is investigated by constructing mechanisms that obey the $\Delta T = 1/2$ rule in the absence of electromagnetic interactions. A boson pole model and a model involving a two-particle intermediate state are considered, and it is found that the contributions to the radiative rate of the former model are of the same order of magnitude as the internal bremsstrahlung contribution. The pole model also furnishes an estimate of the rate for $K_{20} \rightarrow \pi^+ + \pi^- + \gamma$. Author

N64-19488 Princeton U., N.J. Plasma Physics Lab.
CALCULATION OF THE SINGULARITIES OF A MAGNETIC FIELD
John M. Greene Feb. 1964 21 p refs
(Contract AT(30-1)-1238)
(MATT-246)

This note is concerned with one problem that arises when finding the external magnetic field necessary to support a hydromagnetic configuration. If the hydromagnetic configuration is given without regard to the vacuum field that contains it, then that external vacuum field will, in general, have singularities at a finite distance from the fluid-vacuum boundary. Finding the location of these singularities is discussed. Author

N64-19490* Rochester U., N.Y. Inst. of Optics
THE USE OF A SINGLE PLANE PARALLEL PLATE AS A LATERAL SHEARING INTERFEROMETER WITH A VISIBLE GAS LASER SOURCE
M. V. R. K. Murty Repr. from Appl. Opt., v. 3, no. 4, Apr. 1964 p 531-534 refs
(NASA Contract NASr-14)

A high-intensity, interference pattern can be obtained in a shearing interferometer with the use of a visible gas laser and a simple construction. The high intensity of the laser per unit of solid angle gives an interference pattern that is visible in room light. The narrow spectral width of the source allows a simple plane parallel plate to be used to obtain the desired shear. Author

N64-19540 Oklahoma State U., Stillwater. School of Electical Engineering
VIBRATION CONTROL IN RELAY DESIGN
R. L. Lowery, B. C. Riddle, and G. C. Stone *In its* Okla. State U. Papers Presented at the 11th Natl. Conf. on Electromagnetic Relays [1963] 23 p refs (See N64-19501 12-01)

In many applications, the mounting case of the relay is subjected to an external source of vibration. The contacts may randomly separate from the closed position for small periods

of time, or they may chatter or bounce indefinitely after an initial separation. The cause of initial separation of the closed contacts is the fundamental consideration of this paper. Author

N64-19545* Rochester U., N.Y. Inst. of Optics
SOME MODIFICATIONS OF THE JAMIN INTERFEROMETER USEFUL IN OPTICAL TESTING
M. V. R. K. Murty Repr. from Appl. Opt., v. 3, no. 4, Apr. 1964 p 535–538 refs Presented at the Spring Meeting of the Optical Soc. of Am., Jacksonville, Fla., Mar. 1963
(NASA Contract NASr-14)

Described are a few modifications of the Jamin interferometer that are useful for special testing procedures using white light or very broad band filtered light. One modification is useful in testing autoreflection prisms such as cube-corner or right-angle prisms. Another modification is a lateral-shearing interferometer useful in testing mirrors or lenses. With this particular modification it is possible to obtain either a tilt or no tilt in a direction perpendicular to the direction of lateral shear. IAA

N64-19551 RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND A RESOLVENT OF THE PHOTON-DIFFUSION EQUATION
Richard Bellman, Robert Kalaba, and Sueo Ueno Mar. 1964 23 p refs
(ARPA Order 189-61; ARPA-SD-79)
(RM-3937-ARPA; AD-437813)

In the study of radiative transfer, the classical Boltzmann-type approach focuses attention on the statistical behavior of the particles within the medium. There are, however, analytical and computational advantages in the invariant-imbedding approach, leading to the determination of the diffusely reflected and transmitted intensities in slab geometry. The invariant-imbedding technique is useful for studying the internal intensity of radiation in a finite, homogeneous, flat layer. The technique provides a complete solution of scattering problems of light in a finite plane-parallel atmosphere. Author

N64-19552 RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND SCATTERING OF LIGHT IN A ONE-DIMENSIONAL MEDIUM WITH A MOVING BOUNDARY
Richard Bellman, Robert Kalaba, and Sueo Ueno Mar. 1964 23 p refs
(ARPA Order 189-61; ARPA-SD-79)
(RM-3960-ARPA; AD-437762)

The invariant-embedding technique is used for the derivation of integral equations governing the reflection and the transmission coefficients of radiation in a one-dimensional medium with a moving boundary. When formulating the source function, the relaxation of photon emission is considered, assuming that during an elementary act of scattering, a photon remains in a state of absorption for a certain duration of temporal capture. The Schuster problem for a moving one-dimensional medium is treated precisely. When formulating the transfer equations, the influence of the Doppler effect caused by the macroscopic differential motions is a principal cause of frequency change on scattering. Author

N64-19561 RAND Corp., Santa Monica, Calif.
APPROXIMATE RADIATION PROPERTIES OF AIR BETWEEN 2000 AND 8000° K
F. R. Gilmore Mar. 1964 28 p refs
(ARPA Order 189-61; ARPA-SD-79)
(RM-3997-ARPA; AD-437796)

The spectral absorption coefficient for equilibrium air at five temperatures between 2,000° and 8,000° K and six densities between 10 and 10^{-4} times the standard density has been calculated by correcting the 1959 tables of Meyerott, Sokolov, and Nicholls for revised values of the F-numbers of the molecular band systems, and by adding the contributions of several band systems and continua not included by those investigators. The analysis indicates that band systems of NO_2 make an important contribution to the absorption coefficient of air below 6,000° K. Tables of the spectral absorption coefficient, the Planck mean absorption coefficient, the spectral emission coefficient, the total emission rate, and the visible emission rate are included. Author

N64-19580* Rensselaer Polytechnic Inst., Troy, N.Y. Interdisciplinary Materials Res. Center
PROTON MAGNETIC RESONANCE OF SOME CYCLOPROPANE DERIVATIVES
Allan Abrahams, Stephen E. Wiberley, and Frederick C. Nachod Repr. from Appl. Spectr., v. 18, no. 1, 1964 p 13–15 refs Presented at the Pittsburgh Conf. on Anal. Chem. and Appl. Spectry., Mar. 1963
(NASA Grant NsG-100-60)

The proton magnetic resonance of 15 cyclopropane derivatives were studied. In each case the substituent groups were on only one of the ring carbons. The chemical shifts of the four protons on the remaining two carbons were determined to range from δ values of 0.40 to 1.62 ppm, using as an internal reference tetramethyl silane (with $\delta = 0.00$). Direct evidence on the relative electron withdrawing ability of the substituent groups is presented. Author

N64-19581* Pennsylvania State U., University Park
INTENSITY OF THE 4-0 QUADRUPOLE BAND OF MOLECULAR HYDROGEN
John V. Foltz (NASA) and D. H. Rank Repr. from Astrophys. J., v. 138, no. 4, 15 Nov. 1963 p 1319–1321 refs
(NASA Grant NsG (T)-22)

Using the measured relative intensities of the S(1) lines of the 1-0, 2-0, and 3-0 bands in conjunction with theoretical procedures, an extrapolation was produced to determine the relative intensity of the S(1) line of the 4-0 band. The calculation yielded a relative intensity of 25:1 for the 3-0 and 4-0 bands, respectively. The result of the measurements on the relative intensity of the hydrogen quadrupole bands led to the following conclusions: (1) The estimates of 5-km atm and 27-km atm of hydrogen on Jupiter, obtained by previous investigators, are too small. (2) The laboratory measurements and theoretical calculations indicate an amount of hydrogen on Jupiter as much as an order of magnitude greater than 27-km atm. P.V.E.

N64-19606* Stanford Research Inst., Menlo Park, Calif.
THEORETICAL RESEARCH – ELECTRONIC, IONIC, AND ATOMIC IMPACT PHENOMENA Final Summary Report No. 7 [15 Apr. 1962-15 Jan. 1964]
Felix T. Smith 15 Jan. 1964 6 p refs
(NASA Contract NASr-49(07); SRI Proj. PAU-4070)
(NASA CR-53683) OTS: $1.10 ph

This investigation involved: (1) fundamental studies in the field of low-energy electronic, ionic, atomic, and molecular impact phenomena; and (2) theoretical studies specifically related to experimental investigations on low-energy collisions. Results are summarized. A.W.

N64-19633 University of Southern Calif., Los Angeles
PHOTOIONIZATION AND PHOTOIONIZATION-INDUCED ION-MOLECULE REACTIONS Final Report
G. L. Weissler et al 28 Feb. 1964 7 p refs
(Contract AF 19(628)-2452)
(AFCRL-64-168; AD-435601)

Summarized is the work done on the theory that fluorescent radiation will have a different spectral distribution for different energies of the exciting vacuum-ultraviolet photons. The wavelength analysis was achieved by having a second monochromator view the fluorescence chamber in a direction at right angles to the path of the primary ultraviolet photons. Investigation followed of the spectral distribution of fluorescent radiation with the crossed monochromator at a fixed energy of these photons. Gases that were studied and found to produce fluorescence were: CO_2, N_2O, N_2, CO, and O_2, with N_2O the most productive. The wavelength analysis showed agreement with the radiation expected from Pearce and Gaydon band-head data. A.W.

N64-19634 Queen's U., Belfast (Northern Ireland)
THE FINE STRUCTURE OF THE ^2P TERMS OF THE LITHIUM ISOELECTRONIC SEQUENCE
K. L. Bell and A. L. Stewart [1963] 10 p refs
(AF EOAR Grant 63-85)
(AFCRL-64-112; AD-434565)

Ab initio calculations of the fine structure separation of the $1S^2np^2P$, n^- 2, 3 and 4 states of the three-electron systems are made using wave functions of the open shell type. Satisfactory agreement with experiment is obtained only in the case of the highly ionized systems. Author

N64-19730 Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.
GENERALIZED FIELD THEORY
H. C. Corben Sep. 1963 15 p refs
(Contract Nonr-3769(00))
(Rept. 8665-6004-RU-000; AD-420627)

An examination is made of the basic assumptions of relativistic quantum field theory. The assumption that concerns the shape of an elementary particle is shown to be unnecessary. It is concluded that when this assumption is no longer made, basic theory becomes much richer in structure, and leads to a description of isotopic spin, strangeness, and other properties of some of the elementary particles. P.V.E.

N64-19731 Princeton U., N.J. Frick Chemical Lab.
THE MICROCANONICAL ENSEMBLE
Arthur V. Tobolsky Feb 1964 9 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-70; AD-433834)

In the usual development of quantum statistical mechanics, the microcanonical ensemble is introduced to present the basic postulates of this subject with great clarity. Practical calculations of elementary problems using the microcanonical ensemble directly are seldom carried out. Either the method of the most probable distribution is introduced, or the canonical ensemble is introduced. Both of these methods require the development of further mathematical and physical concepts. Elementary methods can be used to develop the thermodynamic properties of monatomic crystals and the "corrected" Boltzmann monatomic gas directly from the basic concepts of the microcanonical ensemble Author

N64-19751 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF THE INCREMENT OF NEUTRON FLUX DENSITY OBTAINED IN THE BREEDING ZONES BY THE ADDITION OF EXTRA REFLECTORS MADE OF VARIOUS SUBSTANCES [ISSLEDOVANIYE PODROVA NEYTRONNOGO POTOKA V ZONAKH VOSPROIZVODSTVA, SOZDAVAYEMOGO DOPOLITEL'NYMI OTRAZHATELYAMI IZ RAZLICHNYKH MATERIALOV]
M. N. Nikolayev, A. V. Zvonarev et al 10 Feb. 1964 25 p refs
Transl. into ENGLISH of a paper presented at the Intern. Atomic Energy Agency Symp. on Exponential and Critical Experiments, Amsterdam, 2–6 Sep. 1963
(FTD-TT-63-977/1+2+4; AD-433527)

Comparison between the experimental and calculated data confirms the ineffectiveness of using ordinary multigroup methods of calculation for obtaining an exact description of the space-energy distributions near the boundaries between two media having fluctuating cross sections. In particular, the use of these methods in determining the best material is unreliable for a supplementary reflector and the optimum holding time of the uranium in the outer layers of the breeding zone. For a uranium shield, the calculated efficiencies of iron and nickel reflectors are almost identical, but actually differ by a factor of almost two. Better calculation methods based on more information concerning the structure of the cross sections are required. Author

N64-19752 Air Force Systems Command, Wright-Patterson, AFB, Ohio
FORMATION OF CATHODE SPOTS AND CURRENT DENSITY DISTRIBUTION IN CATHODE SPOTS OF SHORT-TIME HIGH-INTENSITY ELECTRIC DISCHARGE
E. Zizka 14 Jan. 1964 13 p refs Transl. into ENGLISH from Czech. J. Phys. (Prague), no. 10, 1960 p 327–333
(FTD-TT-63-1071/1+2; AD-433530)

The connection between the current density distribution in a spot and the vapor jets was found for a short-time high-intensity electric discharge by studying the structure of partial cathode traces and by measuring the current density on the cathode. The variation of the current density on the spot with the current gradient was also found, and the etching of the cathode surface with ionic bombardment at a pressure of 760 mm Hg was observed. Author

N64-19755 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEMS OF HIGH-TEMPERATURE THERMOPHYSICS
V. A. Kirillin 3 Dec. 1963 12 p Transl. into ENGLISH from Vestn. Akad. Nauk (Moscow), no. 2, 1963 p 38–43
(FTD-TT-63-1090/1; AD-433534)

Four fundamental directions of high-temperature thermophysics are discussed: (1) thermophysical properties, heat transfer, and physicochemical processes in liquid metals and their vapors; (2) thermophysical properties and heat transfer in gases at high temperatures; (3) thermophysical processes in high-temperature structures and devices; and (4) plasma generators. A.W.

N64-19756 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DIFFUSION OF π-MESONS IN He_3 AND He_4
N. V. Dushin 21 Jan. 1964 7 p Transl. into ENGLISH from Nauchn. Dok. Vysshei Shkoly, Fiz. Mat. Nauki (Moscow), no. 2, 1958 p 162–165
(FTD-TT-63-1093/1+2; AD-433580)

The differential transverse section of the following reaction was determined:

$$\pi + He_3 \rightarrow n_1 + n_2 + n_3 + \pi'.$$

The following reaction of the diffusion of π-mesons in He_4 was also considered:

$$\pi + He_4 \rightarrow n_1 + n_2 + n_3 + \pi'.$$

R.T.K.

N64-19757 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WIDE ANGLE CONDENSERS
A. Sh. Shakhverdov 19 Feb. 1964 8 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 1, 1962 p 43–47
(FTD-TT-63-1098/1+2; AD-433579)

Correction and reduction of spherical aberration in optical systems are discussed. A correction plate, having nonspherical surfaces, is proposed for wide angle condensers. This plate, which is placed between ordinary lenses, weakens spherical aberration and has relatively small deflections. A calculation method is given for producing plates that have the surface form for eliminating spherical aberration. C.L.W.

N64-19775 Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
UNIT CELL HOMOGENIZATION FOR REACTOR DEPLETION STUDIES
Harald A. Risti Apr. 1964 148 p refs
(Contract AT(30-1)-3017)
(WCAP-6060)

Methods for the homogenization of the unit cell of the reactor fuel rod lattice were investigated in order to define procedures for obtaining group diffusion parameters suitable for use in multidimensional, few-group depletion analysis of reactor cores containing plutonium. Heterogeneous effects associated with fast fission, resonance capture, and thermalization were considered along with the influence of fuel rod and moderator temperature distribution in the unit cell. The major emphasis of the study was placed on the resonance energy range. Author

N64-19785 Joint Publications Research Service, Washington, D.C.
SUMMARIES OF PLANS FOR SCIENTIFIC RESEARCH WORK IN THE UKRAINIAN SSR IN 1964-1965
6 May 1964 15 p Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 3, 1964 p 412–416
(JPRS-24494; OTS-64-31217) OTS: $0.50

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N64-19786 Joint Publications Research Service, Washington, D.C.
ON THE STATUS AND PROSPECTS OF THE FUTURE DEVELOPMENT OF SCIENTIFIC RESEARCH ON THE PROBLEM OF "THE SCIENTIFIC PRINCIPLES OF STRENGTH AND DUCTILITY"
In its Summaries of Plans for Sci. Res. Work in the Ukr. SSR in 1964–1965 6 May 1964 p 4–8 (See N64-19785 12-23)
OTS: $0.50

Reported are the kinds of research being done in the areas of elasticity and plasticity, stability and elastic vibrations, and static and dynamic strength. Subjects to which inadequate consideration has been given are enumerated. The Ukrainian Academy of Science Presidium's recommendations for research work are given. R.L.K.

N64-19794* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HARTLEY BAND EXTINCTION COEFFICIENTS OF OZONE IN THE GAS PHASE AND IN LIQUID NITROGEN, CARBON MONOXIDE, AND ARGON
William B. De More and Odell Raper Repr. from J. Phys. Chem., v. 68, no. 2, 1964 p 412–414
(NASA Contract NAS7-100)
(NASA CR-53898; JPL-TR-32-567)

In photolysis of ozone, the extinction coefficients of ozone were determined in the region 2,000–3,100 A in liquid nitrogen and carbon monoxide at 77.4° K, and in liquid argon at 87.5° K. Gas-phase extinction coefficients were measured throughout the region, and the values obtained were generally in close agreement with those reported in previous experiments. R.L.K.

N64-19802 Field Emission Corp., McMinnville, Ore.
DEVELOPMENT OF HIGH PERFORMANCE COLD CATHODE FLASH X-RAY TUBES
Earl C. Cooper and Frank J. Grundhauser 20 Sep. 1963 57 p refs
(Supported by APL/JHU Warhead Group)
(CR-6)

Research was directed toward the development of a low-cost, high-performance, expendable, single-shot X-ray tube. Special emphasis was placed on making the end product compatible with the X-ray systems constructed for the Applied Physics Laboratory. The objectives for the tube development were: (a) a tube type that could economically be used as a single-shot device, (b) a tube that could be usable either on the three-channel pulse transformer system or with the modified Femcor surge pulser, and (c) a tube that would meet the high performance and reliability specifications that are applicable to the multiple-pulse thermal-field (TF) emission and vacuum-arc types. These objectives were all met or exceeded. Author

N64-19824* Johns Hopkins U., Baltimore, Md. Dielectrics Lab.
INVESTIGATION OF THE BEHAVIOR OF DIELECTRIC MATERIALS AT HIGH FIELD STRENGTHS IN A HIGH VACUUM ENVIRONMENT First Quarterly Progress Report, 1 Apr.-30 Jun. 1963
Louis J. Frisco 11 Jul. 1963 29 p refs
(NASA Contract NAS8-5253)
(NASA CR-53878) OTS: $2.60 ph

Research activities in the following areas are discussed: (1) direct-current conductivity—measurements of conductivity of Mylar-C during vacuum exposure (10^{-6} torr range) at temperatures in the range of 25° to 82° C; (2) calorimetric measurement of dielectric losses at high electrical stresses in the radiofrequency range—determination of the relationship between loss factor and field strength at frequencies in the RF range and the relating of these results to the breakdown of dielectrics in the RF range; and (3) alternating-current loss measurements—development of a two-terminal cell for loss-property measurements at temperatures up to 400° C. P.V.E.

N64-19828 Northwestern U., Evanston, Ill.
PROPERTIES OF GASES AT HIGH TEMPERATURES
A. B. Cambel *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 15–18 (See N64-19826 12-01) OTS: $2.75

Extensive computer calculations of the thermodynamic properties of dissociated and ionized gases were made. The information obtained includes internal partition functions for all heavy species, chemical composition, mass density, entropy, internal energy, enthalpy, Gibb's and Helmholtz' free energies, specific heats at constant pressure and volume, and the effective gamma and equilibrium sound speed. The internal partition functions for nitrogen and oxygen were obtained. An interferometer currently being used to study a laminar argon plasma stream is described, and the results of preliminary magnetoaerodynamic drag studies are presented. R.T.K.

N64-19829 Wisconsin U., Madison
THERMONUCLEAR RESEARCH IN WESTERN EUROPE
Donald W. Kerst *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 19–23 (See N64-19826 12-01) OTS: $2.75

An outline of thermonuclear research in progress in the following laboratories is presented: The Royal Institute of Technology, Stockholm, Sweden; The University of Uppsala, Uppsala, Sweden; Danish Atomic Energy Laboratory, Risø; Frascati Laboratory, Italy; Max-Planck Institute, Germany; Institut für Plasma Physik, Germany; Fontenay-Aux-Roses, France; and Culham-Harwell, England. R.T.K.

N64-19847 Missouri U., Columbia
AN ACOUSTICALLY RESONANT STIRLING ENGINE
R. L. Carter and K. T. Feldman, Jr. *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 166–169 refs (See N64-19826 12-01) OTS: $2.75

A thermoacoustical oscillator was examined because of its similarity to a single-cycle Stirling engine. A conventional single-cycle Stirling engine and its idealized pressure-volume and temperature-entropy diagrams are illustrated. The regenerator portion of the engine serves to store heat so that a constant temperature expansion and compression occur in the ideal cycle. The analogous two-cycle, piston-loaded, thermoacoustical engine is also illustrated. This engine is essentially comprised of two Stirling engines operating back-to-back. Diagrams of various types of thermoacoustical converters are included. R.T.K.

N64-19848 Battelle Memorial Inst., Columbus, Ohio
CONVERSION OF ALPHA PARTICLE KINETIC ENERGY INTO ELECTRICITY
A. M. Plummer and J. N. Anno *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 170–180 refs (See N64-19826 12-01) OTS: $2.75

The f-factor (the fraction of alpha particles emerging from the cathode that strike the grid wires) and amplification factor are critical to grid design. Several other factors may also have significant influence on grid design. Examples of such factors are: (1) dependence of secondary electron yield at the grid-on-grid wire material; (2) dependence of secondary yield on electric field; (3) gamma-induced secondary electron emission; and (4) structural strength of the grid. Voltage buildup with the alpha cell was measured for a variety of grid biases. A maximum of 50,000 volts was obtained; this was the upper limit of the equipment. R.T.K.

N64-19850* New Mexico U., Albuquerque Engineering Experiment Station
AN INVESTIGATION OF ELECTRIC CHARACTERISTICS OF THE LUNAR SURFACE Status Report, 1 Nov. 1962-31 Oct. 1963
Nasir Ahmed, James A. Doran, Ahmed Erteza, and Donald H. Lenhert Mar. 1964 34 p refs
(NASA Grant NsG-129-61)
(NASA CR-53880; EE-104) OTS: $3.60 ph

An approach to the study of correlation between pulsed radar and photographic data as a method of supplementing the available statistical information on area-extensive radar scattering surfaces is described. A method of determining an improved estimate of lunar-surface properties is presented. Work has been accomplished on the electronics for the receiving system in the acoustic simulator in preparation for experiments to determine the effect of roughness. Attempts were made to analyze the data taken in the depolarization experiment reported previously. These attempts failed to obtain a solution because of the complexity of the problem involving spherical waves rather than plane waves incident on the target. R.T.K.

N64-19853 Advisory Group for Aeronautical Research and Development, Paris (France)
FUTURE RESEARCH ON NOISE. A ROUND TABLE DISCUSSION
Jean J. Ginoux, ed. Apr. 1963 40 p In ENGLISH; FRENCH summary
(AGARD-469)

Future research on the mechanism of noise generation of turbulent flow was discussed. Elements that can be measured in space–time correlation techniques were an important area covered. An opinion was expressed favoring measuring fluctuating pressure in the stream itself by simple probe measurements. An international program of cooperation between experimental turbulence workers was encouraged. Structural excitation due to turbulence is not sufficiently known. The usefulness of wind-tunnel tests and flight experiments was discussed. G.D.B.

N64-19858 Rochester U., N.Y.
BACKGROUND GAMMA SPECTRA IN A SALT MINE
Albert Rieder and Charles Scholes 27 Apr. 1964 33 p refs
(Contract W-7401-ENG-49)
(UR-641) OTS: $0.75

In the search for a natural, low-gamma background environment, measurements were made in a salt mine with an NaI-crystal detector and a multichannel analyzer. The results were compared with similar measurements in the laboratory under a variety of conditions. In general terms, the gamma background in the mine is 14 times lower than the unshielded laboratory measurements, and about twice the background obtained in the laboratory with the detector surrounded by 8 in. of steel. Author

N64-19859 Aktiebolaget Atomenergi, Stockholm (Sweden)
CALCULATIONS OF TOTAL AND DIFFERENTIAL SOLID ANGLES FOR A PROTON RECOIL SOLID STATE DETECTOR
J. Konijn, A. Lauber and B. Tollander Aug. 1963 33 p refs
Available from AB Atomenergi, Studsvik, Nyköping, Sweden: 8 Sw. cr.
(AE-116)

The solid angles were computed for a proton recoil-counter consisting of a circular hydrogenous foil viewed by a circular solid-state counter, when using an isotropic neutron point source at different distances from the target foil. Tables are given for the total subtended solid angle as well as the differential energy distribution function of the proton recoil spectrum. Also, the influence of finite foil thickness was studied.
Author

N64-19874 Bausch and Lomb Inc., Rochester, N.Y. Research and Development Div.
INFRARED COATING STUDIES Quarter Report No. 3, 15 Sep.-15 Dec. 1963
Leei Chang, Frank Sulzbach, and A. F. Turner [1963] 39 p
(Contract DA-44-009-AMC-124(T))
(AD-429240)

Enhancing the Reststrahlen reflectance of evaporated LiF films by means of essentially nonabsorbing dielectric layers is discussed. Experimental results obtained by coating LiF films with films of germanium and with film combinations of lead chloride and germanium are presented. Computational results on Reststrahlen enhancement are also presented.
Author

N64-19875 RAND Corp., Santa Monica, Calif.
METEOROID CONCENTATION BY THE EARTH'S GRAVITATIONAL FIELD
S. H. Dole Jan. 1964 13 p refs
(P-2832; AD-429108)

In a series of computer runs, a number of low-velocity particles in three-dimensional space were released in the vicinity of the earth in its orbit around the sun, and an earth isolated in space. The positions of particles were then traced through space. The subsequent steady-state concentration of particles around the earth in its orbit around the sun was proportional to the -1 power of the distance from the center of the earth. The concentration of particles was proportional to the -0.68 ± 0.14 power of the distance from the center of the earth isolated in space (theoretical value: -0.50). There is a significant difference in the gravitational concentration of particles around the earth in orbit around the Sun compared with an isolated earth. In the real world, low-velocity particles are gravitationally concentrated by the earth much more than one would expect from looking at a simple model of an isolated earth.
Author

N64-19884 National Physical Lab., Teddington (Gt. Brit.)
PHYSICAL PHOTOMETRY
B. H. Crawford London, HMSO, 1962 24 p refs
(*Its* Notes on Appl. Sci. No. 29) Available from HMSO: is 9d

Those procedures in photoelectric photometry that have proved valuable in precise measurement and that are in regular use at the National Physical Laboratory are described. A discussion is presented of photoreceptors in general. Also discussed are spectral correction of photoreceptors, spectral correction of vacuum emission photocells, spectral correction of radiation thermopiles and bolometers, amplifier details for vacuum emission photocells, and photometers.
R.T.K.

N64-19885 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS, VOLUME I, 1958-1959
S. Tashiro (Japan. Assoc. for Radiation Res. on Polymers) et al Mar. 1964 575 p refs Transl. into ENGLISH of the Publ. "Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, Volume I, 1958-1959"
(AEC-tr-6231) OTS: $6.50

This report contains numerous papers dealing with such subjects as the Van de Graaf accelerator; calorimetric measurement of electron-beam intensity; radiation-induced graft polymerization to polyvinyl alcohol, cellulose, cotton, nylon, and polypropylene; infrared absorption spectroscopy; chlorination of silicones by irradiation; and others.
A.W.

N64-19887 Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS – FISCAL YEAR 1963 Annual Technical Progress Report
1 Apr. 1964 387 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8888) OTS: $6.00

Activities in the following areas are discussed: (1) advance sodium-cooled reactors—sodium reactor experiments, advanced concepts and reactor physics, materials and components, fuels, reactor safety; (2) Hallam nuclear-power facility—evaluation of the performance of fuel elements in the Hallam reactor and providing equipment, methods, and procedures to perform preirradiation and postirradiation examinations of fuel elements; (3) advanced organic moderated reactor—demonstration of the feasibility of the reactor concept, study of the performance of organic moderator feasibility coolants, development of improved coolants; (4) reactor safety—study of reactor-housing installations, fission-product retention by reactor coolants, void formation in organic reactor transients, transients and flow stability, reactor safety studies, measurement of Doppler coefficients; (5) separations chemistry—process initiation (refractory fuels), multicycle reprocessing, basic separations (uranium), new process development; and (6) studies in the advance development program—reactor physics studies; structure, properties, and fission effects in UC and other refractory, interstitial fuels; study of BeO as a reactor material; high-temperature chemistry; radiation chemistry; electronic structure of metals and alloys; radiation damage in crystalline solids.
P.V.E.

N64-19898* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CORRELATION OF LAUNCH-VEHICLE WIND-TUNNEL AERODYNAMIC NOISE WITH SPACECRAFT FLIGHT VIBRATION DATA
Robert A. Schiffer 1 May 1964 11 p refs
(NASA Contract NAS7-100)
(NASA CR-53922; JPL-TR-32-619) OTS: $1.60

It has been observed that the maximum vibration levels experienced by a launch vehicle occur in the regions of q_{max} and transonic flight. Flight vibration data from Ranger spacecraft launches 1 through 6 have been correlated with available wind-tunnel fluctuating pressure data at transonic speeds in order to develop a technique for vibration prediction for types of vehicles that have not previously been flown. Statistical analysis of the wideband vibration data suggests a linear correlation with the wind-tunnel wideband fluctuating

pressure data. Correlation is also explored between the average vibration response spectra calculated by using the empirical method suggested by P. Franken and the 95-percentile log-normal acceleration confidence level obtained by spectral analysis of the flight data. Author

N64-19904 Pratt and Whitney Aircraft, Middletown, Conn.
LCRE VALVE DEVELOPMENT Final Report
Donald E. Smith 4 May 1964 34 p
(Contract AT(30-1)-2789)
(PWAC-401, Pt. II) OTS: $0.75

The lithium-cooled reactor experiment required liquid metal valves capable of 10,000-hour operation in NaK and lithium at 1,200° F and 1,000° F, respectively. Approximately 38,000 hours of liquid metal testing was accumulated on 11 valves prior to termination of the program. Over 10,000 hours of this time was accumulated on isolation-type valves in the NaK circuit of the nonnuclear system test. Type 316 stainless steel valves were exposed to lithium and NaK respectively, with no self-welding or liquid-metal attack. A secondary system valve was endurance-tested in NaK for 10,000 hours at temperatures to 1,500° F. Primary system valves were tested for periods to 4,000 hours at a maximum lithium temperature of 1,000° F. Bellows selected for the valve stem seal were cycled to failure at simulated system pressures and temperatures. The useful life prior to failure was far in excess of the 400 c specified for the LCRE. Punch valve diaphragms of 25-mil thick type 316 stainless steel sheet were successfully tested for 10,000 hours at 1,000° F in lithium with no evidence of leakage. Improved lapping techniques reduced seat leakage rates from over 200 cc to 15 cc per day. Author

N64-19905 Los Alamos Scientific Lab., N. Mex.
ULTRAHIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) Quarterly Status Report, Period Ending 20 Mar. 1964
[1964] 22 p
(Contract W-7405-ENG-36)
(LAMS-3069) OTS: $0.50

This report covers the following areas: facility construction, reactor components, helium blower tests, helium cooling system, gas cleanup system, systems analysis, graphite corrosion, and fuel-element preparation. C.L.W.

N64-19906 Rochester U., N.Y.
K-3 π DECAY AND K_2^0-K_1^0 MASS DIFFERENCE ON CURRENT-CURRENT PICTURE
Riazuddin and A. H. Zimerman 1 Apr. 1964 17 p refs
(Contract AT(30-1)-875)
(UR-875-29)

Some consequences of the current–current picture are considered in connection with K-3π decay and the K_2^0-K_1^0 mass difference. This picture in boson-pole approximation can explain both the decay rates and spectra for the 3π decay modes of K. K_2^0-K_1^0 mass difference is considered in terms of boson-poles approximation and 2 pions intermediate state. The relevant weak coupling constants are estimated on the current–current picture. The sign of the mass difference is positive, and is in agreement with recent experimental indications. The magnitude is somewhat small, but is not excluded by the present experimental situations. Author

N64-19908 Los Alamos Scientific Lab., N. Mex.
COUPLED CORE REACTORS
R. L. Seale 4 May 1964 41 p refs
(Contract W-7405-ENG-36)
(LAMS-2967) OTS: $1.00

The zero-power operation of an array of loosely coupled cores was analyzed to determine the steady state and kinetic behavior of such systems. Over the range of coupling magnitude and coupling time lag considered, there are no coupling-induced resonances in the transfer functions. A large degree of "flux tilting" between the cores of the array can be encountered when reactivity values in the various cores of the array are allowed to vary. An attendant highly unsymmetric-power distribution over the array can then result. Author

N64-19912 Advisory Group for Aeronautical Research and Development, Paris (France)
RECENT EXPERIMENTAL INVESTIGATIONS ON THE SCATTERING OF SOUND BY TURBULENCE
Dieter W. Schmidt (Max-Planck-Inst., Gottingen) Apr. 1963 29 p refs
(AGARD-461)

Experimental investigations of the scattering of sound by turbulence were performed in a wind tunnel. Recent theoretical predictions concerning the sound attenuation are well confirmed and partly extended by the measurements. In the range of the parameters that is of interest for practical applications, the most important results obtained are the proportionality of the sound attenuation to the square of the sound frequency and to the square of the turbulent Mach number. A formula is derived from which the turbulent attenuation of directed sound (such as aircraft noise in the free atmosphere) can be calculated. A method for measuring large phase variations is described in preliminary form; it will be used to investigate the influence of turbulent scattering on the phase angle of the sound waves. Author

N64-19931 Technische Hochschule in Wien, (Austria) Inst. fur Angewandte Physik
X-RAY FLUORESCENCE ANALYSIS OF RARE EARTH METALS Technical Note No. 2
F. Lihl 31 Oct. 1962 25 p refs
(Contract AF 61(052)-609)
(AD-428773)

The problem of analyzing RE-manganese alloys can be solved by means of X-ray fluorescence analysis. The factors that are of influence, such as f.i. matrix effects, excitation conditions, counter statistics, etc., are discussed in detail. A method is given by which RE-manganese alloys—Gd, Sm, Y—(RE: Mn = from 1:100 to 100:1) can be quantitatively analyzed in specimens from 0.001 to 0.02 g with an accuracy of 0.5 percent (relative) and a statistical certainty of 99.7 percent. For the Gd-Mn system the calibration curve, limit of detection (Gd: 0.002 g/1; Mn: 0.001 g/1), and determinable difference of concentration in two specimens are given numerically. Author

N64-19939* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
NEW TECHNIQUE FOR QUANTITATIVE SiO_2 DETERMINATIONS OF SILICATE MATERIALS BY X-RAY DIFFRACTION ANALYSIS OF GLASS
Douglas B. Nash 25 Jul. 1963 30 p refs
(NASA Contract NAS7-100)
(NASA CR-53929; JPL-TR-32-515) OTS: $2.60 ph

Results of an experimental X-ray study on 98 synthetic glasses show that the 2θ positions of glass diffraction maxima have an inverse relation to SiO_2 concentration in silicate glasses. This relationship is the basis of a new technique for semi-quantitative determinations of SiO_2 in silicate materials by

X-ray diffraction methods. Samples to be examined are fused, and the resulting glass is scanned from 12 to 40 deg 2θ using CuKα radiation. The mean 2θ position of the diffraction maximum is a measure of the SiO_2 content of the glass. Calibration curves for both weight and molecular percent SiO_2 vs 2θ are presented. The technique requires only small, unweighed amounts of sample for analysis; it is simple, rapid, and utilizes standard diffraction equipment without modification. Its accuracy, at present, allows SiO_2 determinations to within $\pm 1\%$ to 4% of the actual concentration. Author

N64-19947 Los Alamos Scientific Lab., N. Mex.
NUMERICAL FORMULATION AND SOLUTION OF NEUTRON TRANSPORT PROBLEMS
Bengt G. Carlson 27 Apr. 1964 49 p refs
(Contract W-7405-ENG-36)
(LA-2996)

The numerical techniques for solving the neutron transport equation in arbitrary geometry in the case of discrete treatment of neutron velocity and direction are summarized. The transport problems considered may be stationary or time-dependent and may involve isotropic or anisotropic sources with or without up-scattering. The special case of the diffusion approximation is also briefly discussed. Author

N64-19988* California U., Berkeley Space Sciences Lab.
DYNAMIC BEHAVIOR OF POROUS ELECTRODE SYSTEMS Semiannual Status Report, 1 Sep. 1963-29 Feb. 1964
C. W. Tobias et al 2 Apr. 1964 5 p refs
(NASA Grant NsG-150-61)
(NASA CR-53688; *Its* Ser. 5, Issue 22) OTS: $1.10 ph

The research effort was directed toward measurement of current distribution in a microfissure single-pore cell, and toward development of an apparatus for determination of the effect of changes in the pore structure upon the transient behavior of sintered metal electrodes. R.T.K.

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see:* 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-19299 New York U., N.Y. Courant Inst. of Mathematical Sciences
FINITE AMPLITUDE COMPRESSION WAVES IN A COLLISION-FREE PLASMA
K. W. Morton 15 Jan. 1964 107 p refs
(Contract AT(30-1)-1480)
(MF-36; NYO-10434)

Adiabatic two-fluid equations are set up to describe the one-dimensional motion of a collision-free plasma. These are then used in a study of finite amplitude compression waves, which is built around the consideration of a "magnetic piston problem." The asymptotic behavior of small amplitude waves is considered first. It is found to give a simple but qualitatively correct picture of how the flows depend upon two parameters—θ, the angle the initial magnetic field makes with the direction of wave propagation, and ϵ^2, the electron-ion mass ratio. An exhaustive study is carried out of the steady flows which are useful in the solution of the piston problem. Their character depends markedly on the parameters θ, ϵ^2, and the Alfvén Mach number M_A. The piston problem is solved numerically using finite differences. Author

N64-19300 New York U., N.Y. Courant Inst. of Mathematical Sciences
MODERATELY STRONG OBLIQUE SHOCKS AND SIMPLE WAVES IN STEADY MAGNETOHYDRODYNAMIC FLOW
Y. M. Lynn 14 Feb. 1964 66 p refs
(Contract AT(30-1)-1480)
(MF-38; NYO-10436)

Considered are steady two-dimensional magnetohydrodynamic flow for the general case of nonaligned flow and magnetic-field directions, as well as of arbitrary strength of magnetohydrodynamic interactions. An explicit solution is obtained describing the physical state across either a family of simple waves or an oblique shock of moderate strength. It is derived by expansion of the jump conditions of the state variables across an oblique magnetohydrodynamic shock up to second order with respect to the shock strength measured by Θ, the deflection angle of the flow direction across the wave. The solution corresponds to a correction of linear characteristics solution for small disturbances. The position of an oblique magnetohydrodynamic shock bisects the angle made by upstream and downstream characteristics. Simple solutions for different limiting cases are given. A singularity of the expansion is exhibited and investigated in detail. Author

N64-19304 Los Alamos Scientific Lab., N. Mex.
COMMENTS ON A STEADY-STATE PLASMA ACCELERATOR
T. F. Stratton, J. Todd, and C. V. Weaver 13 Apr. 1964 47 p refs
(LAMS-3041) OTS: $1.00

A series of experiments was completed that had as their object a test of a steady-state electromagnetic plasma accelerator. The accelerator design was unique in that no external source of electrical energy was required. All energy supplied to the accelerator was thermal, and conversion of the thermal flux to a j x B motor force was effected by the principle of the plasma thermionic converter. The working fluid was cesium vapor, and the accelerator was designed to operate in coaxial geometry. Exhaust velocities greater than thermal speed that could be correlated with electromagnetic acceleration were not observed. R.T.K.

N64-19314* California U., Berkeley. Space Sciences Lab.
PLASMAS IN SPACE. UNSTABLE LONGITUDINAL PLASMA OSCILLATIONS Technical Note
Elisabeth A. Cooper and Ann Palm 2 Mar. 1964 47 p refs
(NASA Grant NsG-243-62)
(NASA CR-53821; *Its* Ser. 5, Iss. 13) OTS: $4.60 ph

The linear theory of growing longitudinal plasma oscillations is reviewed because of its importance in explaining ionospheric, interplanetary, and solar phenomena. Dispersion relations are derived for such oscillations in cold and warm collisionless plasmas assumed to be homogeneous in space. Several velocity distributions are considered both without and with an external magnetic field. The physical mechanism of growth is discussed, and the natural phenomena are described that are attributed to this type of plasma instability. Author

N64-19325 Canadian Armament Research and Development Establishment, Valcartier
A STUDY OF SHOCK-CAP RADIATION FROM 1.0 INCH DIAMETER HYPERSONIC SPHERES, PART I: PROJECTILE VELOCITIES TO 17,000 FT. PER SEC.
C. M. Sadowski, J. G. G. Dionne and G. Trottier Apr. 1964 48 p
(ARPA Order 133)
(CARDE-TR-491/64)

Ballistic range measurements have been carried out on the radiation emitted from the shock cap region for 1.0-in.-diam lexan and aluminum spheres traveling with velocities of from 10,000 to 17,000 fps in air at ambient pressures of 76.0, 7.6, and 1.6 mm Hg. The emission was monitored by photomultiplier detectors in the spectral band passes, 2,480 to 2,810 A (NUV), 2,620 to 3,840 A (WUV) and 3,200 to 5,300 A (VIS). The observed radiation intensities were essentially the same for lexan and aluminum projectiles in the spectral windows NUV and WUV. In the visible, i.e., spectral window VIS, ablation from lexan was found to be responsible for producing a greater emission intensity than was observed with aluminum, which is nonablating. The results have been compared with theoretical curves constructed on the basis of an approximate semiempirical equilibrium theory. Author

N64-19385 Radio Corp. of America, Princeton, N.J.
MAGNETOHYDRODYNAMIC POWER GENERATION — STATUS AND PROSPECTS
K. H. Fischbeck. *In* RCA, Camden, N.J. Direct Energy Conversion [1963] p 32–35 refs (See N64-19376 12-06)

Conversion of heat into electrical power by magnetohydrodynamics has been the subject of serious scientific study for the past six years. As time and technical understanding have progressed, both the nature and objectives of such study have changed. The status and prospects for MHD electric power generation, with the emphasis on a systems application, are discussed. MHD power generation is a long-range technical effort with important civilian and military potential. It is not presently predictable that this potential will be realized. Many technical problems remain, and economic factors and the merits of competing systems must continually be reassessed. Market potential and the possibility of solving the problems justify research by any organization aspiring to become a supplier in the new generation of power-conversion equipment. Author

N64-19472 Princeton U., N.J. Plasma Physics Lab.
AN AXIALLY SYMMETRIC MINIMUM B CONFIGURATION
George V. Sheffield. Apr. 1964 23 p refs
(Contract AT(30-1)-1238)
(MATT-256)

A magnetic well is defined as a field configuration in which there exists a finite volume, where the absolute value of the magnetic field strength, $|B|$, has a nonzero minimum. The main objective of this investigation was to arrive at an example of a magnetic well having a substantial mirror ratio and to report its characteristics. The work described is based on a discovery of an error in Andreoletti's work, in which he sought to demonstrate experimentally the existence of magnetic wells. Although his results were not accurate enough to accomplish this, the basic type of configuration he proposed does yield a minimum $|B|$ field; this is verified by the data given in this report. This study has shown that Andreoletti correctly anticipated the existence of a magnetic well for the type of axially symmetric configurations considered. A mirror ratio of 1.2 was achieved without an exhaustive optimization of the system. R.T.K.

N64-19489 Princeton U., N.J. Plasma Physics Lab.
A NOTE ON DIFFUSION OF A CESIUM PLASMA IN A MAGNETIC FIELD
Nicola D'Angelo. Mar. 1964 9 p refs
(Contract AT(30-1)-1238)
(MATT-257)

All data were taken with both tungsten plates heated to temperatures of ~2,300° K. The density measured with a Langmuir single probe at a fixed position is first plotted against the strength of the confining magnetic field. The density is then plotted against the ion flux from the tungsten plate bombarded with cesium atoms for a value of $B \approx 10$ kgauss. The experiment fortified the conclusions reached by D'Angelo and Rynn concerning the diffusion of plasma across magnetic lines. A.W.

N64-19496* Maryland U., College Park
EMISSION OF RADIO NOISE BY PLASMAS
T. J. M. Boyd. Repr. from Phys. Fluids, v. 7, no. 1, Jan. 1964 p 59–63 refs
(NASA Contract NsG-220-62)

This is a study of the generation of radio noise by plasma oscillations, making use of the collisionless Boltzmann equation to describe the electron component of the plasma. A second-order perturbation calculation was made to determine the power spectrum for radiation at the second harmonic of the plasma frequency in a hot plasma in which there is no external magnetic field and the ions are of uniform density. IAA

N64-19608* Ohio State U. Research Foundation, Columbus Antenna Lab.
THE APERTURE ADMITTANCE OF A RECTANGULAR WAVEGUIDE RADIATING INTO A LOSSY HALF-SPACE
R. T. Compton, Jr. 30 Sep. 1963 51 p refs
(NASA Grant NsG-448)
(NASA CR-53514; Rept. 1691-1) OTS: $5.60 ph

The terminating admittance of a rectangular waveguide radiating through a ground sheet into a lossy half-space has been found. Numerical results have been computed for three aperture sizes and are given. If the propagation constant k is imaginary, the aperture admittance is a pure inductive susceptance. For large values of k, the normal aperture admittance is approximately given by k/k_0, independent of the aperture dimensions. Author

N64-19623* Avco-Everett Research Lab., Everett, Mass.
EVIDENCE FOR THE EXISTENCE OF N− FROM THE CONTINUUM RADIATION FROM SHOCK WAVES
R. A. Allen and A. Textoris. Oct. 1963 25 p refs
(NASA Contract NAS9-858; Contract AF 04(694)-33)
(NASA CR-53637; Res. Note 399; BSD-TDR-63-237) OTS: $2.60 ph

This work represents a study of the continuum radiation from shock-heated air and nitrogen as a function of density and temperature. For air or nitrogen in which the molecules are completely dissociated yet only partially ionized, radiation produced by the interaction of electrons with neutral atoms will have a stronger density dependence than the radiation produced by electron interaction with positive ions. Intensity measurements of the continuum at 5000 A were made on the equilibrium region behind incident air and nitrogen shocks in the 9 to 11 mm/μsec range at initial pressures of from 0.1 mm Hg to 1.0 mm Hg. At higher densities, enhanced radiation is observed that can be attributed to the interaction of free electrons with neutral nitrogen atoms. Strong evidence suggests that this radiation is produced by the capture of electrons by nitrogen atoms in the (^2D) state. Author

N64-19631 California U., Berkeley. Electronics Research Lab.
ELECTRON AND PLASMA BEAM DYNAMICS. Final Report [6 Mar.] 1957-[30 Sep.] 1963
Charles Susskind. 31 Oct. 1963 20 p refs
(Contract AF 19(628)-324)
(Rept. 63-26; AFCRL-64-95; AD-435881)

Work was carried out in the following categories: vacuum electronics; gaseous cross-field devices, parallel-field devices, and interaction problems; and electroluminescence studies. Twenty-four scientific reports were published and are summarized. Author

N64-19637 Illinois U., Urbana
SCATTERING OF ELECTRONS AND IONS BY DUST PARTICLES IN A GAS
R. C. Dimick and S. L. Soo Charlottesville, Va. U., School of Eng. and Appl. Sci., Mar. 1964 14 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(Tech. Rept. ILL-14-P; AD-433862)

Interaction of a partially ionized gas with dust particles was studied. Results show modification of an earlier approximation by Rosen with consistent degree of approximation. Author

N64-19645 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
AN EXPERIMENTAL DETERMINATION OF ANTENNA PATTERN DISTORTION DUE TO A PLASMA LAYER Research Note
Daniel J. Jacavanco and Gerald Meltz Jan. 1964 10 p refs
(AFCRL-64-18; AD-436821)

Measured radiation patterns of a plasma-covered antenna are compared with an approximate leaky wave analysis by Oliner and Tamir. The results clearly show a shift in the optics' "critical angle" and the appearance of several side lobes as predicted by theory. The plasma is produced in a He–Xe admixture at 0.4 torr by a capacitively coupled 10-mcps-cw-source, and contained in a rectangular pyrex vessel of interior dimensions 8 in. by 4 in. by 5 in. Electron densities in excess of 5×10^{11} per cc are measured by a standard microwave interferometer manually by balancing a bridge or automatically by displaying a set of interference "fringes" after a pattern is recorded. Author

N64-19649 Miami U., Coral Gables, Fla.
DIFFUSION OF PLASMAS ACROSS A MAGNETIC FIELD Final Report, 1 Mar. 1963-28 Feb. 1964
Behram Kursunoglu [1964] 36 p refs
(Contract AF 19(628)-2844)
(AFCRL-64-277; AD-436197)

Experimental investigation of transport processes in cesium arc plasmas shows classical ambipolar diffusion across low magnetic fields, convective transport associated with the helical instability at intermediate fields, and a return apparently to diffusive transport and relatively good confinement at magnetic fields 10 to 20 times the critical field for the onset of the instability. In theoretical studies the methods of Brownian motion are used to describe the diffusion of electrons and ions in a plasma across a magnetic field in the presence of an anisotropic dynamical friction. The bivariate distribution function of a plasma in a magnetic field and the partial differential equation that it satisfies are found, and the distribution function is used to calculate the diffusion coefficients. Author

N64-19717 Princeton U., N.Y. Plasma Physics Lab.
MEASUREMENT OF PLASMA PRESSURE AND TEMPERATURE
A. F. Kuckes Jan. 1964 11 p
(Contract AT(30-1)-1238)
(MATT-250)

The inductive coupling between two loops that encircle a plasma confined in a magnetic mirror can be used to measure the plasma pressure. If a pulse of current is passed through one loop, a voltage will be induced in the second; the plasma-associated voltage thus induced will be shown to be related to the perpendicular plasma pressure. Studied is a plasma subject to a magnetic perturbation that is slow compared to the longitudinal period of both the ions and electrons. The response of a plasma with hot electrons and cold ions is treated. An acoustic wave is launched whose phase velocity is related to the parallel electron temperature and whose amplitude is related to the perpendicular plasma pressure. Author

N64-19729 Avco-Everett Research Lab., Everett, Mass
SEGMENTED ELECTRODE LOSSES IN MHD GENERATORS WITH NONEQUILIBRIUM IONIZATION
Jack L. Kerrebrock Apr. 1964 30 p refs
(Contract AF 04(694)-414)
(Res. Rept. 178; BSD-TDR-64-35; AD-437129)

A theory is proposed to account for the effect of joule dissipation near a segmented electrode wall, on the electrical conductivity near the wall. In MHD generators designed to produce nonequilibrium ionization due to electron heating, the elevation of conductivity will occur first near the electrode wall, because the joule heating of the fluid is much greater there than in the free stream. This local increase of conductivity will tend to cause a flow of current in the Hall direction amplifying the dissipation, and greatly reducing the current density and elevation of electron temperature that can be attained in the generator. Another theory is proposed that accounts for these phenomena in predicting generator performance as a function of the usual variables, plus the ideal electron temperature rise. The predicted maximum Hall potentials agree qualitatively with those measured by Klepeis and Rosa in a 1/2- x 3-inc generator channel. Author

N64-19735 Rensselaer Polytechnic Inst., Troy, N.Y.
RESEARCH IN HYPERSONICS AND MAGNETOHYDRODYNAMICS
Z. S. Chang, R. E. Duffy, R. F. Hoppmann, D. F. Rogers, T. R. Sundaram et al Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Jan. 1964 183 p refs
(Contract AF 33(616)-7312)
(ARL-64-5; AD-436729)

This final report of research in hypersonics consists of three major sections: (1) the description of the hypersonic shock tunnel and calibration shock tube used in the research; (2) a detailed description of the experiments carried out in nonequilibrium fluid dynamics, rarefied gas dynamics, and plasma physics; and (3) a discussion of theoretical studies undertaken, particularly in the field of nonequilibrium inviscid flow. A.W.

N64-19749 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONTROLLED THERMONUCLEAR REACTIONS
Ping Yi 19 Feb. 1964 5 p Transl. into ENGLISH of a book review from K'o Hsueh T'ung Pao (Peking), no. 1, 1963 p 69
(FTD-TT-63-915/1+3+4; AD-433577)

This review concludes that the book under discussion will be of use to physicists working on the investigation of controlled thermonuclear reactions and, because it covers plasma physics and magnetohydromechanics, will also serve as a reference work for scientists in cosmoelectrodynamics and rocket propulsion. A.W.

N64-19789* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DAMPING OF QUANTIZED LONGITUDINAL PLASMA OSCILLATIONS

E. H. Klevans, P. B. Burt, and C.-S. Wu 15 Apr. 1964 17 p refs
(NASA Contract NAS7-100)
(NASA CR-53875; JPL-TR-32-553) OTS: $1.60 ph

Although the damping of longitudinal plasma oscillations has received considerable study for both classical plasmas and degenerate electron gases, expressions for damping in the degenerate systems at arbitrary temperatures have not been obtained. In this report, the damping in the degenerate electron gas at arbitrary temperatures is evaluated within the random phase approximation (RPA) in the long-wavelength limit. In addition, exchange damping for a plasma slightly above the degeneracy temperature is evaluated and is shown to be comparable to the RPA damping for a wide range of parameters. Author

N64-19831 Wisconsin U., Madison
DESIGN OF AN EXPERIMENT FOR PRODUCING SUPERSONIC HIGH ELECTRON DENSITY PLASMA
H. N. Powell *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 29–36 refs (See N64-19826 12-01) OTS: $2.75

The experimental design aspects of a research program on electron recombination in "cool" supersonic (potassium seeded) plasmas are outlined. A honeycomb-screen assembly was used in the design of a high-enthalpy shock tube in order to produce a short-duration and steady supersonic flow of conventional gases in a moderately large diameter duct (6 inch). A schematic representation is included of the recommended supersonic plasma tunnel. R.T.K.

N64-19832 Northwestern U., Evanston, Ill. Gas Dynamics Lab.
VISCOELECTRIC MAGNETOHYDRODYNAMIC ANALOGY
Thomas P. Anderson *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 37–39 (See N64-19826 12-01) OTS: $2.75

A set of equations is given that describes the flow of an incompressible, electrical, neutral conducting fluid having constant scalar transport properties and negligible displacement and Hall currents. Another set of equations is given that governs viscoelectric flow. These equations can be used to verify experimentally the velocity and pressure distributions in magnetohydrodynamic flows. R.T.K.

N64-19833 Northwestern U., Evanston, Ill. Gas Dynamics Lab.
INDUCTION COUPLED PLASMA TORCH
Paul D. Scholz, Morris E. Brodwin, and Thomas P. Anderson *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 40–42 (See N64-19826 12-01) OTS: $2.75
(Partially supported by Pure Oil Co.)

A radiofrequency induction-coupled plasma torch was used in the experiments reported. A variable-frequency, 5- to 22-megacycle, 5-kilowatt vacuum-tube oscillator was used. The magnetic fields surrounding the coil were sufficient to sustain the plasma, but an inductively heated carbon rod was used to initiate the operation. The thermionically emitted free electrons were then accelerated by the oscillating axial magnetic field of the coil, and an avalanche-collisional ionization initiated the plasma generation. Circuit frequencies were determined. The calculated and the measured values of the unloaded circuit frequencies agree within a few percent. R.T.K.

N64-19834 Northwestern U., Evanston, Ill.
THERMOPHYSICAL PROPERTIES OF PLASMA
R. C. Warder, Jr. *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 43–44 (See N64-19826 12-01) OTS: $2.75

An investigation of the electrical properties of argon and nitrogen plasma flows was conducted in an arc-heated plasma tunnel, using microwave diagnostics. Phase-shift and attenuation measurements at 78 kmc and 85.3 kmc were made to determine the electron density and electron collision frequency of the plasma flows. A wall-stabilized arc was found to offer the most rewarding results in the investigation of the transport properties of an argon plasma. The thermodynamic state generated in argon, in a conical-type electromagnetic shock tube, was determined from time-integrated and time-resolved spectroscopic observations. R.T.K.

N64-19842 Illinois U., Urbana
PLASMA DIAGNOSTICS USING ELECTROMAGNETIC WAVES
J. T. Verdeyen *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 113–125 (See N64-19826 12-01) OTS: $2.75

The interaction of microwaves with a plasma and the use of the laser for studies concerning plasmas of high charge density are discussed. The "cavity" and "transmission" plasma-measuring techniques are described. The phase information, usually found in "fringe shifts" in conventional interferometers, shows up as amplitude modulations of the laser output. It is shown that the sensitivity of the interferometer can be improved considerably by using spherical mirrors for the cavity containing the unknown plasma. R.T.K.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-19305* Rice U., Houston, Tex.
SPIN-LATTICE RELAXATION IN RUBY
P. L. Donoho Repr. from Phys. Rev., v. 133, no. 4A, 17 Feb. 1964 p A1080–A1084 refs
(NASA Grant NsG-6-59)

Spin-lattice relaxation times for ruby of very low Cr concentration at low temperature are computed for the one-phonon Kronig–Van Vleck process, using the spin-lattice Hamiltonian derived by Van Vleck and taking the vibrational anisotropy of the crystal into account. The relaxation times are computed as functions of the angle between the applied magnetic field and the *c* axis, temperature, and frequency. Reasonably good agreement with experimentally determined relaxation times is obtained. Author

N64-19349* Rensselaer Polytechnic Inst., Troy, N.Y.
CARRIER LIFETIME STUDIES IN ELECTRON-(10-55 Mev) AND PROTON-(25-110 Mev) IRRADIATED GERMANIUM
J. E. Fischer and J. C. Corelli [1964] 41 p refs Submitted for Publication
(NASA Grant NsG-290)
(NASA CR-53782) OTS: $4.60 ph

Samples of single-crystal germanium were irradiated at room temperature with electrons of energies from 12 Mev to 55 Mev, and with protons of energies from 25 Mev to 109 Mev. Measurements of the minority carrier lifetime as a function of flux and of initial carrier concentration suggest that: (1) More than one recombination level is introduced into the

forbidden gap by the defects created during electron and proton bombardment, with the multilevel effect being greater for the proton-irradiated specimens. (2) Nonlinearity of the defect introduction rates of two-proton irradiated samples may be due to the closing of channels and the resulting decrease in the number and range of "stenons" (channeled knockons). (3) The carrier lifetime change with increasing proton energy does not decrease as sharply as predicted by Rutherford scattering and the Kinchin–Pease model. (4) The energy dependence of carrier lifetime change in the case of electron bombardment is complicated by a nonconstant contribution of multiple levels to the recombination process in the electron-energy range studied. R.T.K.

N64-19448 Joint Publications Research Service, Washington, D.C.
HELIUM-NEON GASEOUS BODY IRRADIATOR
Teng Hsi-ming, Tu Chi-lu, Sung Ts'ung-wu, Wu Ch'ang-shu, and Ch'iu P'ei-Hua *In its* Transl. on Communist China's Sci. and Tech., No. 80 27 Apr. 1964 p 1–3 refs (See N64-19447 12-01) OTS: $2.00

The experimental results of a helium–neon gaseous body irradiator are discussed. The oscillating phenomenon of interference light was observed, and an output-light power of 0.5 milliwatt, a wavelength of 6328 A, and an emitting angle of excited light less than 3×10^{-3} radians were obtained. P.V.E.

N64-19546 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
PLASTIC DEFORMATIONS AND METAL FATIGUE [DEFORMATIONS PLASTIQUES ET FATIGUE DES METAUX]
William G. Barrois 3 Oct. 1952 140 p refs In FRENCH
(ONERA-TM-27(1963))

This analysis of recent works on metal fatigue and on plastic deformations emphasizes the duality of mechanical cold rolling, i.e., simultaneous hardening and relaxation. The state of hardening of a metal should therefore be defined by a statistical distribution of the geometrical characteristics of the distortions of the atomic lattice and by a statistical distribution of the stability of these distortions. A study is made of known facts in the area of metal plasticity. This study results in an elucidation of some hypotheses concerning the elementary phenomena of hardening and restoration and of the effect of three factors of external stress, namely, constraint, time, and temperature. These hypotheses, which are not contrary to the established facts pertinent to recrystallized materials, martensitic transformation, and structural hardening by precipitation, enable the reaching of an understanding of the fatigue mechanism in metals. Trans. by I.v.L.

N64-19548 Union Carbide Research Inst., Tarrytown, N.Y.
ELECTRICAL PROPERTIES OF SOME TRANSITION-METAL CARBIDES AND NITRIDES
John Piper Apr. 1964 28 p refs
(Contract DA-30-069-ORD-2787)
(C-21; AD-435624)

The results of a study of the Hall effect as a function of temperature, electrical resistivity, and superconductivity of the face-centered cubic carbides and nitrides of the IVth and Vth group transition metals are reported and interpreted in terms of a rigid band model. The results indicate that when the total electron concentration is increased, as in the solid-solution series ZrC-NbC-NbN, the additional electrons enter an energy band that is nearly empty for ZrC. Superconducting critical temperatures and published magnetic susceptibility measurements suggest that the band over a large part of its span has an effective mass ~5m, where m is the free electron mass. Author

N64-19550 Lehigh U., Bethlehem, Pa. Surface Chemistry Lab.
STUDIES OF THE SURFACE AND COROLLARY ELECTRICAL PROPERTIES OF GERMANIUM Final Report, 16 Apr. 1961–29 Feb. 1964
A. C. Zettlemoyer, R. D. Iyengar, and W. M. Block [1964] 15 p refs
(Grant DA-SIG-36-039-61-G5)
(AD-434381)

The original model developed for the adsorption of propanol on crushed *n*-type germanium single crystals was extended to water adsorption. According to this model, water functions as a donor during the adsorption, and the higher the electron concentration in the boundary layer of germanium, the less the amount of water adsorbed. Water adsorption on a GeO_2 powder reveals that chemisorption characteristics of the oxide are very similar to those of germanium surfaces covered with an oxide layer. Studies on crushed *p*-type Ge single crystals support the model developed earlier. Experiments under uhv are being made on the resistance changes of thin single crystal wafers of variously doped germanium, due to adsorption of different ambients including H_2O, propanol, O_2, and N_2O. Author

N64-19562 Carborundum Co., Niagara Falls, N.Y.
A STUDY OF FUNDAMENTAL MECHANICAL PROPERTIES OF CERAMIC SINGLE CRYSTALS Final Report
R. S. Liebling 12 Mar. 1964 41 p refs
(Contract N600(19)-59749)
(AD-437383)

The object of this investigation has been to study the factors influencing the strength of silicon carbide single crystals and to develop methods of producing extremely strong crystals of predictable strength. Using platelet crystals, cut to desired lengths and widths and having uniform thicknesses, it was possible to account for 81 percent of the variations in fracture loads using an equation derived from the test data. Various abrasive and chemical treatments were employed to modify crystal surfaces. A number of crystals were tested at 1,750° C. Immersion in molten cryolite for 5 to 10 min and heating seem to improve strength, but with the exception of a few crystals, no crystals exhibited bend strengths over 150,000 psi. Author

N64-19628 Radio Corp. of America, Princeton, N.J. RCA Labs.
INVESTIGATION OF TWO-CARRIER INJECTION ELECTROLUMINESCENCE Scientific Report No. 1
A. G. Fischer 15 Mar. 1964 67 p refs
(Contract AF 19(628)-3866)
(AFCRL-64-189; AD-437573)

Injection electroluminescence starting at 1.35 v has been found in physical inversion layers of metal-semiconductor contacts to n-type ZnSe crystals. N-type ZnTe crystals have electron mobilities of 340 $cm^2/v/sec$ at room temperature. Incorporation of rare-earth ions in II-VI crystals has been accomplished. A new materials combination for tunnel-injection-EL diodes has been devised. A unified theory of recombination kinetics via centers has been written that covers the excitation, quenching, and stimulation of luminescence and their relationship with photoconductivity and optical absorption. A model of nearest-neighbor-split luminescence levels in mixed crystals is presented that accounts for the peculiar emission spectra of Zn(S:Se):Ag. Author

N64-19662 Radio Corp. of America, Princeton, N.J. RCA Labs.
INVESTIGATIONS OF FUNDAMENTAL LIMITATIONS DETERMINING THE ULTIMATE SIZE OF MICROSTRUCTURES Final Report, 1 Jan. 1961-31 Dec. 1963
R. J. Evans, A. G. Revesz, and J. T. Wallmark 31 Jan. 1964 24 p refs
(Contract AF 19(604)-8040)
(AFCRL-64-136; AD-436802)

The work described in this report covers the following fields: (1) theoretical analysis of fundamental limitations of size and component density of semiconductor and other devices, and an analysis of redundancy in unipolar transitor circuits; and (2) theoretical and experimental work on physical techniques that may have a direct bearing on the ultimate size of microstructures. The investigations covered some aspects of the growth of silicon by gaseous reactions, and of the growth and properties of SiO_2 films on silicon. Author

N64-19665 Technical Operations Research, Burlington, Mass.
LOSS FACTORS AFFECTING RUBY LASER SYSTEMS Final Report
J. Masters, J. Ward, and E. M. E. Murray 31 Jan. 1964 75 p refs
(Contract AF 19(628)-405)
(AFCRL-64-151; TO-B-64-5; AD-437608)

Efficient high-power output performance of ruby lasers depends on reducing the effect of storage losses, or losses of atoms from the excited state that occur during the pumping phase, and internal propagation loss suffered by stimulated emission. Both types are strongly dependent on geometric parameters. Internal propagation losses were significant in ruby ($\sim$ 35% per transit in a typical 2-in. ruby rod). Storage loss due to nonlinear de-excitation during pumping is important under atypical conditions. Preliminary measurements of the nonlinear de-excitation due to spontaneous-emission amplification were performed under nonstandard operating conditions and showed $\sim$ 50% inversion loss for a large, cooled ruby sample. The limitations of simple physical models of ruby laser systems are discussed in detail. Important influences of mode coupling and mode selection on the threshold condition for oscillation in ruby lasers are reported. Author

N64-19674 Cutler-Hammer, Inc., Deer Park, N.Y.
STUDY OF SOLID-STATE AND TRAVELING-WAVE MASER TECHNIQUES
J. A. De Gruyl, W. W. Heinz, S. Okwit, and J. G. Smith Griffiss AFB, N.Y., RADC, Mar. 1964 42 p refs
(Contract AF 30(602)-2989)
(RADC-TDR-64-115; AD-437906)

The major effort has been confined to broadbanding the maser and investigating the limiters. A comb-type slow-wave-structure test section, 3.3-in. long, has been designed and fabricated. This structure has an exceptionally large slowing-bandwidth product and relatively low loss. The structure bandwidth was greater than 500 mc with an average slowing factor of about 70 and an insertion loss of less than 3 db. Ferrite isolator disks, integrated in the structure, provided isolation approaching 20 db. Two novel approaches to the limiter were analyzed and measured: a thin-film superconducting limiter and a bulk semiconductor limiter. Both approaches appear to be capable of yielding the desired protective characteristics. Author

N64-19711 Atomics International, Canoga Park, Calif.
PREPARATION OF URANIUM MONOCARBIDE SINGLE CRYSTALS
H. Nadler 30 Apr. 1964 65 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7465) OTS: $1.50

Single crystals of uranium monocarbide (UC), 1/4 in. in diameter by 2-in. long, were prepared from arc-melted rods of stoichiometric and off-stoichiometric compositions by a two-step process. An arc-melted rod was float-zone melted in an electron beam furnace to form a superstoichiometric two-phase structure, in which uranium dicarbide (UC_2) platelets precipitated along the [100] crystallographic planes of the UC matrix. Subsequent decarburization of the UC_2 platelets by hydrogen reduction produces a UC single crystal. Precise control of the decarburization process was required to achieve stoichiometry. Author

N64-19727 Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
DESIGN OF A MOLECULAR AMPLIFIER GROUP [Final Report, Dec. 1961-Jan. 1963]
S. Okwit, K. Siegel, and J. G. Smith Wright-Patterson AFB, Ohio, ASD, Jan. 1963 58 p refs
(Contract AF 33(600)-038862)
(Rept. 5945-3; ASD-TDR-63-684; AD-413407)

The results of a study program are discussed to design, develop, and fabricate a traveling-wave maser system having a magnetic field obtained from a superconducting magnet. The maser uses a ruby-loaded comb structure operating at a bath temperature of 4.2° K. It is tunable from 2,195 to 2,320 mc, having stable net gains in excess of 30 db with an instantaneous bandwidth of about 17 mc. Gain stability is accomplished by integrally including yttrium-iron garnet-isolator disks. Effective maser noise temperature (T_e) measurements, made with a hot and cold load noise generator, yielded $T_e \approx 7.5°$ K. The superconducting solenoid, consisting of niobium-zirconium wire, has a working diam of 7.5 in., a length of 5 in., and weighs under 3 lb. It is capable of supplying stable magnetic fields up to 4,320 gauss at a coil current of 6.2 amp. The magnetic field supplied by the solenoid to the operating maser is nominally 2,500 gauss. The high degree of homogeneity yielded by this small-length solenoid results from a high-μ material magnetic loading technique, without which a coil length of over 25 in. is required. Author

N64-19737 Electro-Optical Systems, Inc., Pasadena, Calif.
RESEARCH ON ORGANIC COHERENT ELECTROMAGNETIC RADIATION MATERIALS Final Report, 15 Jun. 1962-15 Jun. 1963
L. Nugent, S. Lee, J. Burns, and R. Stephens Wright-Patterson AFB, Ohio, ASD, Aug. 1963 101 p refs
(Contract AF 33(657)-9395)
(EOS-3180-Final; ASD-TDR-63-685; AD-416659)

The parameters pertinent to high-power laser emission from organic materials are examined in relation to the Schawlow–Townes threshold condition. Many β-diketone chelates of Eu^{3+}, Tb^{3+}, and Sm^{3+} are suitable laser materials, while the chelates of the other tripositive rare-earth ions are either borderline or unsuitable for laser applications. A list of the suitable chelates is presented, and pertinent spectroscopic properties are given. Materials that emit radiation via a fluorescent process are unsuitable for laser applications. Organic laser host materials found suitable were ethanol–methanol mixtures and EPA for a liquid laser, methylmethacrylate and epoxy resin for plastic hosts, and $Al(AA)_3$ for a single crystal host. A series of rare-earth chelates were laser tested at low temperatures in both liquid and solid solutions. Test results were inconclusive. Author

N64-19740 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TEMPERATURE DEPENDENCE OF MAGNETOSTRICTION AND COEFFICIENT OF LINEAR EXPANSION OF ELINVAR
A. Ya. Vlasov and B. A. Ayurzanayn 15 Feb. 1963 9 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), no. 6, 1962 p 99–102
(FTD-TT-63-7/1+2+4; AD-298776)

Results are reported of experiments on the regularity of change of the linear expansion coefficient of elinvar alloys with a temperature change. The investigations were conducted on three sample discs (37% nickel, 7.56% chrome, 54.44% iron) 20 mm in diameter and 2 mm thick that were at first vacuum annealed at 1,050° C for 2 hours and then cooled down in the oven. Magnetostriction was measured by wire pickups glued on the surface of the sample at angles of 0.45° and 90° relative to the direction of the magnetizing field. The ferromagnetic nature of the anomalies of thermal expansion of elinvar alloys was confirmed by the experiments performed. A.W.

N64-19771 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF PHOTO EXCITED TRIPLET STATES OF POLYATOMIC MOLECULES BY THE EPR AND PHOSPHORESCENCE METHOD
A. K. Piskunov, R. N. Nurmukhametov et al 28 Feb. 1964 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 27, no. 5, 1963 p 634–637
(FTD-TT-64-183/1+2; AD-433584)

This is an investigation of the electron paramagnetic resonance (EPR) of frozen (77° K) solutions of certain compounds of the hydrocarbon series and compounds having heteroatoms with EPR: hexane, isopropyl and ethyl alcohols, isopentane, and in solid matrices, polystyrene and polymethylmetacrylate. At the same time, the spectra and lifespan of the fluorescence of the compounds were measured. Among the results found are the following: (1) When ethyl alcohol is irradiated with filtered light (λ = 365 mμ) no radicals were detected; however, when a luminophore molecule was entered into the matrix, radicals were observed, the form of which did not depend upon the structure of the luminophore and coincided with the form of signals found in pure alcohol when it is exposed to unfiltered light. (2) When naphthalene + benzophenone and phenanthrene + benzophenone systems were irradiated with filtered light (λ = 365 mμ) in ethyl alcohol and in polymethylmethacrylate, EPR signals from naphthalene and phenanthrene were observed, whereas the same compounds yielded no signals when benzophenone was absent. P.V.E.

N64-19812 HP Associates, Palo Alto, Calif.
ADVANCED FUNCTIONAL ELECTRONIC BLOCK DEVELOPMENT Interim Engineering Report No. 5, 1 Sep. 1963–30 Nov. 1963
R. J. Archer et al [1963] 102 p refs
(Contract AF 33(657)-9772)
(AD-428185)

Detailed studies of the capacitance and of the V-I characteristics and emission bands as a function of temperature have been made for zinc-diffused GaAs diodes. Conclusions are drawn concerning the injection mechanisms and recombination processes for both the component of the current that gives rise to recombination radiation and for "leakage" current. GaAs el diodes have been fabricated by depositing epitaxial n-type material on p-type substrates. The optical and electrical properties at 77° K and 300° K are reported. The present method for assembling the optic amplifier consisting of a GaAs el diode and a Si phototransistor is described. Coupling problems are discussed, and a number of new designs for the device are presented. The chemistry of GaAs epitaxial film growth was studied. The dependence of the deposition rate and of the morphology of the films on the Ga:As ratio in the vapor phase was established. Author

N64-19839 Purdue U., Lafayette, Ind.
THE TEMPERATURE DEPENDENCE OF THE CONTRACT RESISTANCE OF AN IRON PLATED LEAD TELLURIDE CONTACT
G. C. Jain and W. B. Berry *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 78–86 refs (See N64-19826 12-01) OTS: $2.75

It is shown that the electrodeposited iron on lead telluride contact resistance is positive and increases with increasing temperature. The experimental results indicate the temperature dependence is positive and may be simply represented as $\rho_0 \propto T^x$, where ρ_0 is the contact resistivity and x is in the range of 2 to 3. Author

N64-19881 National Research Corp., Cambridge, Mass.
COHESION OF COPPER AND STEEL REPEATEDLY FRACTURED AND REJOINED IN VACUUM
John L. Ham New York, SAE [1963] 8 p refs Presented at the Automotive Eng. Cong., Detroit, 14–18 Jan. 1963 (NASA Contract NASr-48)

The tendency of clean metal surfaces to stick together was tested to determine materials for bearings, electrical contacts, and slip rings that will be used in space or lunar explorations. The cohesion of copper and soft steel, repeatedly ruptured and rejoined in vacuum at room temperature, initially decreases with each successive fracture–rejoin cycle, even when exposure is too low to permit formation of a monolayer of gas on the fractured surfaces, and even when the joining stress is too low to cause measurable plastic strain. At 500° C, the cohesive stress for steel is nearly constant for at least four cycles, with time in contact ranging from 1 to 6 minutes. For copper at 400° C, cohesion was only 70% after 2-hr contact on the first cycle, due to excessive exposure, but was time dependent and reached 75% in 12 hr. A.L.B.

N64-19886 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
SOLID STATE DIFFUSION IN METALS AND ALLOYS
S. D. Gertsriken and I. Ya. Dekhtyar Apr. 1964 536 p refs Transl. into ENGLISH of the book "Diffuziya Metallakh i Splavakh v Tverdoi Faze", Moscow, Gos. Izd. Fiz.-Mat. Lit., 1960 564 p
(AEC-tr-6313) OTS: $6.00

The use of radioactive isotopes in research on diffusion in metals made possible the understanding of the mechanism involved in the process, and permitted estimates of the fundamental significance of this process in a great variety of problems of solid-state physics. The principal results of the research proved that diffusion processes are governed by the character of the interatomic interaction in the metal and its structure. It is significant that the diffusion parameters, usually determined in high-temperature measurements, are of great importance in many processes that occur in metals and alloys at both high and normal temperatures. A.W.

N64-19917 Joint Publications Research Service, Washington, D.C.
INVESTIGATING THE CONDITIONS FOR OBTAINING HIGH-PURITY ALUMINUM BY ZONE RECRYSTALLIZATION

V. N. Vigdorovich et al 4 May 1964 15 p refs Transl. into ENGLISH from Zavodsk. Lab. (Moscow), no. 1, Jan., 1964 p 47–54
(JPRS-24459; OTS-64-31199) OTS: $0.50

Experimental investigation showed that obtaining aluminum of high purity by the method of zone recrystallization was best done by electric resistance heating as against induction heating (when working with graphite boats and conducting the process in a vacuum). Preliminary filtration, although not connected with the direct purification of the aluminum from impurities, increases the effectiveness of the subsequent zone purification and stabilizes the structure and homogeneity of the distribution of impurities in the ingots. Preliminary degassing of aluminum lowered its contamination by impurities of magnesium at the expense of a decreased effectiveness of purification from other impurities. Zone recrystallization of "distillation" aluminum allows additional increase of its purity. A combination of both methods of purification should be used only for the less pure products of the "distillation" method of purification and the reguluses of smaller sizes. By melting the "dirty" ends of ingots and their additional zone recrystallization, it is possible to obtain aluminum with a decreased content of impurities of transitional metals of the IVa, Va, and VIa groups of the periodic system ($K > 1$). Author

N64-19933 Battelle Memorial Inst., Columbus, Ohio
STUDY OF SEMICONDUCTING PROPERTIES OF SELECTED RARE-EARTH METALS AND COMPOUNDS
J. F. Miller, F. J. Reid, L. K. Matson, and R. C. Himes Wright-Patterson AFB, Ohio, Res. and Tech. Div., 31 Dec. 1963 71 p refs
(Contract AF 33(657)-10687)
(RTD-TDR-63-4231; AD-428091)

A number of selected compounds and alloys of the rare-earth elements, cerium, neodymium, samarium, gadolinium, erbium, and ytterbium, in combination with the elements of Chemical Groups V and VI, arsenic, antimony, selenium, and tellurium were prepared and their electrical properties studied. Data obtained on crystal structures indicated that, in the M-Se and M-Te systems, four types of crystalline phases exist: the MX, MX_2, and MX_4 compounds, and a single phase spanning the M_3X_4-M_2X_3-composition range. Other properties investigated included carrier concentration, carrier mobility, electrical and thermal conductivity, and Seebeck coefficient as functions of temperature and composition. The electrical characteristics of these refractory materials ranged from those of high-resistivity semiconductors to those of metallike conductors. Several device applications suggested include high-temperature thermoelectric generator materials, thermistors and related devices, controllable-temperature-coefficient resistors, and refractory, active device elements. Analyses were made of electrical conduction in the NdSe-SmSe-alloy system and of chemical bonding prevailing in M_3X_4-M_2X_3 selenide and telluride phases. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-19650 Weismann Inst. of Science, Rehovot (Israel)
SHALLOW FOCUS EXPLOSION IN A LIQUID SPHERE
Technical Note No. 8
Z. Alterman and P. Kornfeld 10 Jan. 1964 51 p refs
(Contract AF 61(052)-509; Proj. Vela-Uniform)
(AFCRL-64-183; AD-436540)

An exact solution is obtained for the motion of a fluid sphere due to pressure-pulses from point-sources situated near the surface. The solution reveals doublet-pulses and accumulation of pulses, which have no counterpart in deep-focus sources. Author

N64-19651 Lockheed Propulsion Co., Redlands, Calif.
SOLID PROPELLANT STRUCTURAL INTEGRITY INVESTIGATIONS. DYNAMIC RESPONSE AND FAILURE MECHANISMS Final Report
Dalton Cantey 17 Apr. 1964 169 p refs
(Contract AF 04(611)-8539)
(LPC-618-F; RPL-TDR-64-32, Vol. 1; AD-437140)

Discussed is the correlation of mechanical response and failure in solid propellants with basic material structural characteristics. Propellant dynamic physical properties and structural failure phenomena were studied in detail. Major emphasis was directed at the problems of propellant viscoelastic properties and failure mechanisms together with examination of the effects of propellant binder and filler physical characteristics on its behavior. Measurements of viscoelastic properties of propellants using transient techniques are demonstrated, and results are presented. Investigation of propellant viscoelastic properties in dynamic shear is also discussed. Failure criteria studies are presented in which propellants were tested. Conclusions are given on the isolation of a maximum tensile stress failure criterion, and on methods of engineering evaluation of propellants. Subcontract research, directed at problems in photoviscoelasticity, finite viscoelasticity, dynamic problems in finite viscoelasticity, and heat generation due to forced vibrations, is documented. Classified material (formulation data) for propellants studied in the program are presented. Author

N64-19709* California U., Berkeley, Calif.
RECENT PROGRESS IN DETONATION RESEARCH
A. K. Oppenheim, N. Manson (Poitiers U.), and H. G. Wagner (Göttingen U.) Repr. from AIAA Journal Oct. 1963 p 2243–2252 refs Presented at the AIAA Summer Meeting, Los Angeles, 17–20 Jun. 1963
(NASA Grant NsG-10-59; AF AFOSR Grant 129-63)

This report is concerned with three problems—the development of the wave, its stability, and its structure. Studies were made of the generation of pressure waves by accelerating flames, and observations were noted of the onset of transverse oscillations at the moment of origination of the retonation wave. It appeared that small-amplitude, high-frequency oscillations are almost universally apparent; low-frequency instability is associated with actual combustion-zone separation from the shock front. Evidence was produced to favor the concept of the von Neumann–Döring–Zeldovich theory, according to which the detonation consists of two distinct wave fronts—the shock and the deflagration. It was not established that the wave process is a sequence of equilibrium states, and, at least under one set of operating conditions, the wave was found to be turbulent in character. A.W.

N64-19728 Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
AN ANALYSIS OF SOME ASPECTS OF THE WENOGRAD THERMAL STABILITY EXPERIMENT
Joseph D. Clem, Jr. and W. H. Growtzinger, III 3 Mar. 1964 32 p refs
(Contract DA-01-021-ORD-11878(Z))
(S-44; AD-432598)

An analysis was made of some aspects of the Wenograd experimental technique for investigating the thermal stability of explosives at high temperatures. A mathematical model of the experiment was formulated; the equations were solved numerically and investigated parametrically. Results indicated that first estimates of the activation energy and preexponential factor of the explosives may be obtained from analysis of the experimental data. Author

N64-19742 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME RESULTS CONCERNING THE DISTRIBUTIONS OF DROPS OF FUEL ATOMIZED THROUGH LOW-PRESSURE INJECTORS
Cornel Ungureanu 12 Mar. 1963 15 p refs Transl. into ENGLISH from Energetica (Bucharest), v. 4, no. 3, 1961 p 94–100
(FTD-TT-63-29/1+2+3+4; AD-400552)

This paper reports results obtained in experiments on the density of fuel distribution over a perpendicular section on the longitudinal axis of an injector and the cone angle of the jet. It was found that the spray density on such a section at a specific distance differs from one stage to another, conforming to the law of normal distribution, and that the values of the maximum of the distribution curve and the error modulus depend on the specific distance from the injector's mouth. Fuel distribution over the section flow depends on the combination of nozzle and cap, with the spray density increasing as the divergence angle of the cap decreases. A.W.

N64-19759 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF THE DETONATION OF CONDENSED EXPLOSIVES
L. D. Landau and K. P. Stanyukovich 6 Feb. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 46, no. 9, 1945 p 399–402
(FTD-TT-63-1112/1+2; AD-433493)

This reports a mathematical evolution of equations applicable to the modern hydrodynamic theory of detonation of condensed explosive substances. Parameters computed by these equations are presented in tabular form for the following explosive substances: tolite, tetryl, picric acid, and tenite. A.W.

N64-19852 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
PEACEFUL USES FOR NUCLEAR EXPLOSIVES Selected Annotated Bibliography
Hugh E. Voress, William F. King, and Carl R. Gerber, comp. Jan. 1964 59 p refs
(TID-3522(Rev. 7)) OTS: $1.25

The references are arranged by subject, including Excavation, Projects Sedan and Gnome, and Natural Resources Development. There are also author and availability indices. R.L.K.

N64-19941* Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
A THEORETICAL STUDY OF NONLINEAR COMBUSTION INSTABILITY: LONGITUDINAL MODE
William A. Sirignano Mar. 1964 255 p refs
(NASA Grant NsG-99-60)
(NASA CR-53870; Tech. Rept. 677) OTS: $16.50 ph

Periodic solutions of finite amplitude are found for two different models of nonlinear longitudinal wave-type oscillations in a rocket combustor. In the first model, the characteristic time of the combustion process is negligible compared to the wave travel time in the chamber or, equivalently, in the period of oscillation. In the second model, the wave travel time and the characteristic time of the combustion process are of the same order of magnitude, so that a phase can exist between energy addition and pressure. Preliminary data indicate qualitative agreement between theory and experiment on both a premixed gas rocket (for the first model) and a liquid rocket (for the second model). R.T.K.

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-19348 Pennsylvania State U., University Park
HYDROCARBON CONTENT OF THE BLOWBY GASES OF AN AUTOMOTIVE DIESEL ENGINE Report No. II
C. E. Chevalier May 1962 35 p refs
(Contract PH 86-62-24)

The hydrocarbon content of the crankcase breather gases of an automotive diesel engine, a 6-cylinder Cummins Model JT-6-B1 installed on a dynamometer, was investigated at all conditions that might reasonably be expected to occur in actual use. The blowby gases were analyzed for total hydrocarbon content in a hydrogen flame ionization detector. The absolute amount of emitted hydrocarbons was found to be very small, even with overfueling, after prolonged idling when undercooled, with more than normal blowby, etc. By means of experiments with different fuels, different crankcase oils, and the response of the emissions to changes in operating conditions, it could be shown that the hydrocarbons in the blowby gases originate primarily from the lubricating oil. The total unburned-hydrocarbons (expressed as hexane) crankcase emission rate was from 0.03% to 0.07% of the fuel rate. Author

N64-19411 Philco Corp., Palo Alto, Calif. Research Labs.
A REVIEW OF NOZZLE CONCEPTS FOR FUTURE SOLID PROPELLANT ROCKET MOTORS Special Technical Report
W. H. Armour, R. L. Mitchell, W. L. Smallwood, and E. W. Peterson Mar. 1964 131 p refs
(Contract AF 04(611)-8387, Suppl. Agreement No. 1)
(RPL-TDR-64-8; U-2551; AD-436296)

A review is given of heat transfer and corrosion analyses, materials, and thermal protection methods for both cooled and uncooled rocket nozzles for solid-propellant rocket motors. Other pertinent aspects pertaining to rocket nozzles are also presented. Author

N64-19477* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
STATUS OF ELECTROSTATIC THRUSTORS FOR SPACE PROPULSION
William R. Mikelsen and Harold R. Kaufman Washington, NASA, May 1964 128 p refs
(NASA TN D-2172) OTS: $2.75

Current research programs are described for electron-bombardment thrustors, contact-ionization thrustors, and colloidal-particle thrustors. The critical component in the electron-bombardment thrustor is the cathode, and recent data indicate that durable, low-power cathodes can be developed. The performance of the contact-ionization thrustor is severely limited by porous-tungsten technology. Colloidal-particle thrustors are still in the research stage but appear to have the

best promise for high efficiency at low specific impulse, low mass, and programed specific impulse operation. Author

N64-19479* Arde-Portland, Inc., Paramus, N.J.
NUCLEAR ROCKET ENGINE NOZZLE STUDY Final Report
Sidney Elkind 3 Feb. 1964 140 p refs
(NASA Contract NAS3-3670)
(NASA CR-54000; A-P-FR-20516) OTS: $10.50 ph

A study was made of selected aspects of nuclear nozzles, and an uncooled design for long duration firings was evolved. Nozzle walls that are adequate with limited cooling were investigated, and two designs that could be cooled with 5% of core gas flow are described. The effects of startup and shutdown were treated, and use of gas side coatings was investigated. Internal heat generation due to gamma heating was considered, and the methods of computing transient temperature distributions are reviewed. Limited stress analysis and comparative weights for both cooled and uncooled nozzles are reported. Author

N64-19483* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EVALUATION OF FILAMENT DETERIORATION IN ELECTRON-BOMBARDMENT ION SOURCES
Nelson L. Milder and William R. Kerslake Washington, NASA, May 1964 41 p refs
(NASA TN D-2173) OTS: $1.00

The attrition of refractory-metal (tantalum) filaments operating in electron-bombardment ion sources using mercury as the propellant was measured from the time variation of filament resistance. Two basic filament geometries, ribbon and wire, were studied in two separate facilities under varying conditions of ion discharge voltage and emission current density. The results indicate that the primary factors contributing to filament deterioration were the sputtering caused by ion bombardment and the chemical action of residual gases in the facility on the hot filament surface. The presence of mercury vapor had negligible effect on the initial attrition rate in the absence of an ion discharge. A correlation was found among the initial attrition rate, the ion discharge voltage, and the emission current density. Author

N64-19750 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMPOSITE AIRCRAFT ENGINES
Fl. Zaganescu 11 Feb. 1964 9 p Transl. into ENGLISH from Stiinta si Teknica (Bucharest), no. 5, 1961 p 32–33
(FTD-TT-63-957/1+2; AD-433526)

The advantages of modern aircraft engines can be exploited to the full by designing combinations, utilizing engines of various types as the powerplant on board. Various combinations are proposed, such as using a ramjet engine and a rocket motor, and a turbojet and a rocket. Also, installation ideas are suggested such as mounting one engine inside another. The limitations and effectiveness of various types of engines and their combinations are mentioned. R.L.K.

N64-19840 Illinois U., Urbana
CHARGED PARTICLE PROPULSION: A DOUBLE ENERGY-CONVERSION PROBLEM
Charles D. Hendricks *In* Argonne Natl. Lab. AMU-ANL Conf. on Direct Energy Conversion, Nov. 4–5, 1963 Dec. 1963 p 89–99 (See N64-19826 12-01) OTS: $2.75

An electrically sprayed liquid-droplet source of heavy particles was investigated. The parameters that were found to affect the spraying process are flow rate, capillary diameter, spraying potential, conductivity, viscosity, temperature and surface temperature. Specific charge distributions are included for glycerine and carbon–glycerine sprays, and dibutyl phthalate spray. R.T.K.

N64-19888 Joint Publications Research Service, Washington, D.C.
GAS TURBINES IN AIRCRAFT PROPULSION
G. S. Zhiritskiy et al 12 May 1964 733 p refs Transl. into ENGLISH of the book "Gasovyye Turbiny Aviatsionnykh Dvigateley" Moscow, Oborongiz, 1963 p 1–608
(JPRS-24549; OTS-64-31240) OTS: $8.50

This book discusses the working processes in gas turbines (various types), methods for the thermodynamic and gasdynamic analysis of turbines under design and transient conditions, systems for cooling the hot portions of the turbine and methods of analysis of these systems, and the design and stress analysis of the main components of the turbine. A brief review of actual gas turbine designs is presented. Author

N64-19890* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
PROPULSION IMPROVEMENTS ACHIEVED DURING FLIGHT TESTING OF SATURN VEHICLES
B. K. Heusinger N.Y., AIAA [1964] 11 p Presented at the AIAA Aerospace Propulsion Meeting, Cleveland, 4–6 May 1964 (AIAA Paper 64-537) AIAA: $0.50 members, $1.00 nonmembers

A description is given of the improvements on a one-million pound Saturn vehicle propulsion system for earth orbit and deep-space probes. A correlation was made between the propellants and the payloads for each of the different Saturn vehicle stages. Improvement measurements were determined by installing a flowmeter in each propellant suction line to establish individual engine and total vehicle flow rates. A.L.B.

N64-19926* Space-General Corp., El Monte, Calif. Space Operations Div.
INTEGRATED ENGINE FOR SPACECRAFT Final Report, 18 Apr. 1962–18 Sep. 1963
R. L. Border and C. A. Lysdale [1963] 234 p refs
(NASA Contract NAS7-140)
(NASA CR-53924; SGC-206-FR-1) OTS: $15.50 ph

Summarized are studies conducted to see if using part of the spacecraft structure for nozzle surfaces to provide high-nozzle area-ratio and minimum structure weight is practical. A wide array of integrated concepts is presented, and two concepts are evaluated in detail to determine their relative payload capability with that of a reference conventional vehicle. Nozzle frictional drag was a critical factor, and an experimental study was performed to determine frictional drag losses in 2 and 3 dimensional nozzles. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-19301* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. III. THE DYNAMICS OF CORONAL STREAMERS

E. N. Parker Repr. from Astrophys. J., v. 139, no. 2, 15 Feb. 1964, p 690–709 refs
(NASA Grant NsG-96-60)

The solar corona may consist of thin radial filaments and streamers, rather than an amorphous atmosphere. The filaments and streamers are confined by the magnetic field, along whose lines of force they lie. To investigate the consequences of a filamentary corona for the solar wind, the dynamics of an idealized corona composed of gaseous streamers, with vacuum between the streamers, is worked out. Conclusions are that the streamers occupy most of space at large radial distance from the sun, no matter how small a fraction they may occupy at the sun. The velocity of the solar wind is not greatly affected by filamentary structure for a given coronal temperature distribution. The mean-wind density is not affected by more than a factor of 2. Except for the presence of some thin interstreamer regions, there is no great effect of a filamentary structure on the mean values of the solar-wind velocity and density at a large distance from the sun. If the corona is composed principally of streamers, the Helmholtz instability may be expected to disorder and mix up the streamer and interstreamer regions beyond some distance O (1 a.u.) from the sun. Author

N64-19326 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF COSMOGONY, VOLUME VI
30 Apr. 1964 413 p refs Transl. into ENGLISH of the collection of articles "Voprosy Kosmogonii," Vol. VI Moscow, Acad. of Sci. USSR, 1958 p 1–368
(JPRS-24435; OTS-64-31190) OTS: $6.00

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1. THE ORIGIN AND LINES OF DEVELOPMENT OF CONTINENTS AND OCEANS V. A. Magnitskiy p 1–45 refs (See N64-19327 12-12)

2. RECENT DATA ON THE DETERMINATION OF THE ABSOLUTE AGE OF THE EARTH V. I. Baranov p 46–63 refs (See N64-19328 12-12)

3. HISTORY OF THE ROTATION OF THE MOON AND THE RHEOLOGICAL PROPERTIES OF ITS SUBSTANCE B. Yu. Levin p 64–70 refs (See N64-19329 12-05)

4. THE GROWTH OF TERRESTRIAL PLANETS V. S. Safronov p 71–88 refs (See N64-19330 12-05)

5. THE ORIGIN OF THE SOLAR SYSTEM H. Alfven p 89–108 refs (See N64-19331 12-05)

6. THE PROCESSES OF THE DISINTEGRATION OF LIGHT QUANTA AND THEIR SIGNIFICANCE IN THE PHYSICS OF GAS NEBULAE A. Ya. Kipper and V. M. Tayt p 109–124 refs (See N64-19332 12-05)

7. THE PHYSICS OF PLANETARY NEBULAE V. V. Sobolev p 125–177 refs (See N64-19333 12-05)

8. THE DYNAMICS OF PLANETARY NEBULAE G. A. Gurzadyan p 178–238 refs (See N64-19334 12-05)

9. LIGHT PRESSURE AND THE DYNAMICS OF PLANETARY NEBULAE I. N. Michin p 239–252 refs (See N64-19335 12-05)

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11. MAGNETOGASDYNAMICS AND PROBLEMS OF COSMOGONY S. A. Kaplan p 274–304 refs (See N64-19337 12-05)

12. THE MAINTENANCE OF ISOTOPIC ABUNDANCE IN THE FORMATION OF ELEMENTS P. G. Parkhomenko p 305–308 refs (See N64-19338 12-05)

13. THE LOCATION OF AN EQUILIBRIUM THERMONUCLEAR MEDIUM P. G. Parkhomenko p 309–315 refs (See N64-19339 12-05)

14. THEORIES OF THE "EQUILIBRIUM" ORIGIN OF ELEMENTS S. B. Pikel'ner p 316–317 refs (See N64-19340 12-05)

15. THE PRESENT STATUS OF COSMOLOGY G. N. Naan p 318–373 refs (See N64-19341 12-05)

16. THE BUDAPEST CONFERENCE ON VARIABLE STARS HELD AT THE HUNGARIAN ACADEMY OF SCIENCES, 23–28 AUGUST 1956 B. V. Kukarkin p 374

17. SYMPOSIUM ON PROBLEMS OF ELECTROMAGNETIC PHENOMENA IN COSMIC PHYSICS Ya. P. Terletskiy p 375–378

18. A CONFERENCE ON VARIABLE STARS P. N. Kholopov p 379–395

19. CONFERENCE ON THE PHYSICS OF PLANETARY NEBULAE B. A. Vorontsov-Vel'yaminov p 396–400

20. CONFERENCE OF THE COMMITTEE ON COSMOGONY DEVOTED TO PROSPECTS FOR THE DEVELOPMENT OF EXTRAGALACTIC ASTRONOMY AND COSMOLOGY Ye. L. Ryskol p 401–402

21. SIXTH COSMOGONIC CONFERENCE F. A. Tsitsin p 403–410

N64-19424 Library of Congress, Washington, D.C. Aerospace Information Div.
PHOTOMETRY OF SOLAR FLARES [FOTOMETRIYA SOLNECHNYKH VSPYSHEK]
M. G. Karimov, A. S. Zubtsov, M. I. Antushevich, and S. K. Dosybayev 17 Apr. 1963 18 p Transl. into ENGLISH of an article from Izvest. Akad. Nauk Kazakh. SSR (Alma-Ata), v. 14, 1962 p 93–106
(AID-T-63-49; AD-403860) OTS: $1.60 ph

The results of the photometric processing of solar flares of importance observed during IGY are presented. The observations were made at a high-mountain coronal station, 2,600 m above sea level, in the region of Great Alma-Ata Lake, with the aid of the type-AFR-2 chromosphere-photosphere telescope. A motion picture was taken in the H_α line with an interference-polarization filter having a pass-band width of 0.6 A. Standard 35-mm panchromatic high-sensitivity photographic film was used. The rate of filming was 2 frames a minute. Standardization and calibration were effected through the insertion of a reducing screen with 9° of transparency, illuminated by the solar disk. The screen was inserted during normal, twice-normal, and four-times-normal exposures. The films were developed using the standard contrast-type fine-grain developer. Author

N64-19462 Joint Publications Research Service, Washington, D.C.
THE ACTIVE REGIONS OF THE SOLAR CORONA
G. D. Ivanov-Kholodniy *In its* Probl. of Cosmogony, Vol. V 27 Apr. 1964 p 185–228 refs (See N64-19451 12-05) OTS: $4.00

A survey was made of the existing observational data on the yellow corona and on the spectral contours of the coronal lines. Also discussed is the question of the identification of spectral lines, with special reference to the yellow lines of the corona. Author

N64-19585* California U., San Diego
EFFECTS OF COSMIC RAYS ON METEORITES
Masatake Honda and James R. Arnold Repr. from Science, v. 143, no. 3603, 17 Jan. 1964 p 203–212
(NASA Grant NsG-321)

Unlike the earth's atmosphere, the meteorites are physically and chemically stable targets. They are more suitable than terrestrial targets for an extended study of the fossil

record of cosmic radiation. The topics discussed include: (1) course of radiation in a meteorite; (2) history of meteorites; (3) secular equilibrium; (4) time variations of the cosmic radiation; (5) meteorite samples; (6) measurement techniques; (7) cosmic-ray age; (8) production rates; and (9) the analysis of recovered artificial satellites. R.T.K.

N64-19615* Iowa State U., Iowa City
LARGE DIURNAL VARIATIONS OF GEOMAGNETICALLY TRAPPED AND OF PRECIPITATED ELECTRONS OBSERVED AT LOW ALTITUDES
L. A. Frank, J. A. Van Allen, and J. D. Craven Mar. 1964 33 p refs
(NASA Grant NsG-233-62; Contract Nonr-93803)
(NASA CR-53829; SUI-64-5) OTS: $3.60 ph

A large, similar diurnal variation of the intensities of geomagnetically trapped and of precipitated electrons is observed in data obtained with the low-altitude satellite Injun III over the period December 1962 to Septe ber 1963. The northern limit of detectable electron ($E \geq 40$ kev) intensities was at $L \approx 20$ ($\Lambda \approx 77°$) at local noon and at $L \approx 8$ ($\Lambda \approx 69°$) at local midnight. Several polar plots of the median intensities of electrons as a function of local time and the shell parameter L (and Λ = arc cos $L^{-1/2}$) are displayed. A local acceleration mechanism for electrons ($E \geq 40$ kev) on the sunward side of the magnetosphere is suggested by an apparent maximum of precipitated electron intensities near local noon at $L \approx 8$. Author

N64-19638 Instituto Geofisico del Peru, Huancayo
ON THE CENTER-LIMB EFFECT OF SOLAR FLARE AREA Technical Note
Osamu Takahashi 1963 40 p refs
(Contract AF 49(638)-637)
(AD-437509)

The visual flare area has been corrected by a factor of sec θ for the real flare area. As a result of this correction, however, a discrepancy was brought into the distribution of the flare area with respect to the central distance of the disk; this discrepancy has been explained as due to the flare height. This paper gives an actual proof of the existence of two different parts in the foreshortening effect of visual flare area and then gives the normalized correction of flare area. These two parts are the geometrical distortion and the vanishing effect near the limb. Author

N64-19639 Instituto Geofisico Del Peru, Huancayo
PRELIMINARY MEASUREMENT OF H-ALPHA FLARE SPECTROGRAMS Technical Note
Mutsumi Ishitsuka, Osamu Takahashi, Francisco Dominguez Vigo, Wilma Gonzales de Dominguez, and Enrico Mattlevich Feb. 1963 22 p refs
(Contract AF 49(638)-637)
(AD-437506)

Twenty-two spectrograms were taken successively with short time intervals, in a narrow spectral region centered in the hydrogen H-alpha line, throughout a solar flare event detected on September 7, 1962. Six of those spectrograms were traced with a microphotometer. Three spectrograms covering the same spectral region, obtained from the normal region of the sun, were traced with the microphotometer. The resultant profile was compared with the profile mentioned in the Utrecht Atlas. The ratio of the equivalent width of H-alpha line in the normal observed profile to that of the Utrecht profile amounted to 0.80. Author

N64-19673 Denver U., Colo.
THE SPECTRAL RADIANCE OF THE SUN FROM 4$_\mu$ TO 5$_\mu$
Frank H. Murcray, David G. Murcray, and Walter J. Williams 4 Feb. 1964 24 p refs
(Contract AF 19(604)-7429; ARPA Order 363-62)
(DRI-2145; AFCRL-64-84; AD-435806)

The radiance of the solar disc was measured as a function of wavelength from 4.0μ to 5.0μ with a spectral radiometer system that was calibrated in terms of absolute radiance. The measurements were taken at an altitude of 31 km and are relatively unaffected by the terrestrial atmosphere. The radiance values are presented at 0.1μ intervals over the 1.0μ range, and it is shown that the effective radiation temperature of the solar disc decreased from 5,626° K ± 100° K at 4.0μ to 5,270° K ± 150° at 5.0μ. This result represents the only measurements that have been made of solar radiance vs wavelength beyond 2.5μ, so no direct comparison is available, however, the result fits with a single measurement that has been made at longer wavelengths. Author

N64-19797 California U., Berkeley
Final Report, 1 Oct. 1962-30 Sep. 1963 [BALLOON FLIGHT STUDY OF THE ATMOSPHERE]
R. R. Brown Mar. 1964 6 p refs
(AF AFOSR Grant 62-422)
(AFOSR-424; AD-433709)

Features of the summer balloon-flight study of the earth atmosphere are discussed. The flight program was designed to study the structure of electron precipitation and the ionospheric-absorption effects due to solar protons and alpha particles. In addition, the program explores the structure and time variations of the radiation effects at high latitudes as well as their correlation with optical emissions. A total of 12 simultaneous flights between Ft. Wainwright and Ft. Yukon showed strong X-ray effects and provided further information on the northern boundary of electron precipitations. All of the above balloon flights were equipped with radiation detectors, which were supplemented with photometers (both visible and ultraviolet). A.L.B.

N64-19869 Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
MEASUREMENT OF SOLAR RADIO RADIATION AT 430 MEGACYCLES Quarterly Status Report, Oct. 1, 1963-Dec. 31, 1963
T. Gold 15 Jan. 1964 45 p refs
(Contract Nonr-401(27))
(CRSR-161; AD-428914)

A description is presented of a 430-mc/s polarimeter. The feed system for the polarimeter consists of crossed two-element Yagi antennas placed at the focus of the 17-ft parabolic reflector. The signal outputs from each linear-orthogonal feed antenna, one of which is delayed 90 degrees, are fed to a four-port hybrid ring. The outputs from the ring are opposite circular polarizations, and each output feeds one of the two main-receiver channels. The two channels receive the same RF band, but separate local oscillators and separate mixers translate the two RF bands into IF bands shifted by 1,000 cps. The IF signals are mixed (multiplied), and the 1,000-cycle component is filtered out. The phase of the 1,000-cycle output, as compared to a reference derived from the local oscillators, is also determined. The information obtained is sufficient to completely determine the polarization of the incoming waves. P.V.E.

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-19310* Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOG OF PRECISELY REDUCED OBSERVATIONS, NO. P-12
Phyllis Stern, comp. 28 Feb. 1964 84 p refs
(NASA Grant NsG-87-60)
(NASA CR-53819; SAO Special Rept.-148) OTS: $8.10 ph

Precisely reduced observations of the following are included: (1) Satellite 1960 β1 (rocket body Tiros 1) from April 5 through June 1, 1960, (2) Satellite 1960 β2 (Tiros 1) from April 5 through September 21, 1960, (3) Satellite 1961 o1 (Transit 4A) from August 5, 1961, through December 31, 1962, and (4) Satellite 1961 o2 (Injun-Solar Rad 3) from August 5, 1961, through December 31, 1962. R.T.K.

N64-19355 Kyoto U. (Japan)
CONTRIBUTIONS FROM THE INSTITUTE OF ASTROPHYSICS AND KWASAN OBSERVATORY
1963 105 p refs
(*Its* Contrib. 124, 125, 126)

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1. METEOROLOGICAL OBSERVATIONS OF MARS DURING THE 1962–63 OPPOSITION S. Miyamoto p 1–80 refs (See N64-19356 12-29)
2. OBSERVATIONAL STUDY ON THE GENERAL CIRCULATION OF MARS S. Miyamoto p 81–88 refs (See N64-19357 12-29)
3. A THEORY ABOUT THE INTERNAL COMPOSITION AND DEVELOPMENT OF THE MOON P. Hevervari 16 p refs (See N64-19358 12-29)

N64-19356 Kyoto U. (Japan)
METEOROLOGICAL OBSERVATIONS OF MARS DURING THE 1962-63 OPPOSITION
S. Miyamoto *In its* Contrib. from the Inst. of Astrophys. and Kwasan Obs. 1963 p 1–80 refs (See N64-19355 12-29) (*Its* Contrib. 124)

In Martian spring, the Propontis–Cerberus and Nilokeras–Lacus vapor courses were well developed and very dark, whereas the Utopia–Nodus Laocoontis course was somewhat fainter than in the 1960 opposition. Compared with the 1960 opposition, the polar cap in 1963 was larger, and in late spring, the retreat of the cap stopped and even increased its dimension for a while. The Casius-Neith yellow cloud appeared at the same season as in the last opposition, and in summer, an outburst of the Noachis white cloud was observed across the equator. The doldrum was conspicuous in spring. It followed the subsolar point and faded in summer. Author

N64-19357 Kyoto U. (Japan)
OBSERVATIONAL STUDY ON THE GENERAL CIRCULATION OF MARS
S. Miyamoto *In its* Contrib. from the Inst. of Astrophys. and Kwasan Obs. 1963 p 81–88 refs (See N64-19355 12-29) (*Its* Contrib. 125)

In the Martian atmosphere, contrary to Earth, meridional circulation is more important than lateral mixing. Energy flows from pole to equator in summer. The prevailing winds over the middle latitude turns into easterlies during this season. An attempt is made to prove these particular circulation regimes with the observational data available. It is pointed out that local topographic circulations make important contributions to the general circulation. The topographical difference of northern and southern hemispheres should be taken into account in establishing the actual circulation pattern. Author

N64-19358 Kyoto U. (Japan)
A THEORY ABOUT THE INTERNAL COMPOSITION AND DEVELOPMENT OF THE MOON
Peter Hevervari *In its* Contrib. from the Inst. of Astrophys. and Kwasan Obs. 1963 16 p refs (See N64-19355 12-29)
(*Its* Contrib. 126)

On the basis of astrophysical considerations, the pressure and density distribution of the moon is calculated. These calculations indicate the following: (1) No significant magnetic field or Van Allen belt exists around the moon. (2) The moon is quasi-homogeneous. (3) The density of the moon is also similar to that of the earth's mantle. (4) The thickness of the moon's crust is of the same order of magnitude as in the case of the earth. (5) The continents represent the original crust of the moon. (6) There are no basins as yet on the moon's surface. (7) The transformation of the metallic core of the moon supplied essentially more energy than that necessary to produce tectonic processes on the moon. R.T.K.

N64-19417 Wolf Research and Development Corp., West Concord, Mass.
DIFFERENTIAL ORBIT CORRECTION AND STATION LOCATOR PROGRAM "DOC-II" Scientific Report No. 3
Richard M. Moroney and Isabel M. Hussey Feb. 1964 228 p refs
(Contract AF 19(628)-2379)
(AFCRL-64-55; AD-430735)

A description is given of the analysis and programing for performing a differential correction to orbital elements and station positions from weighted observations of range, range rate, azimuth–elevation, and right ascension–declination on close earth satellites. The ephemeris computation considers perturbations due to the earth's gravitational potential as described by a spherical harmonic representation through $n = m = 5$, the lunar gravitational potential, air drag, and radiation pressure. All observations may be simulated in punched-card form for conducting geometric studies. Author

N64-19566 IIT Research Inst., Chicago, Ill. Astro Sciences Center
A SURVEY OF MISSIONS TO THE ASTEROIDS
A. L. Friedlander and R. S. Vickers [1963] 109 p refs
(NASA Contract NASr-65(06))
(NASA CR-53729; Rept. M-3) OTS: $9.10 ph

A survey has been made of possible missions to the asteroid belt, and to asteroids whose orbits bring them in close proximity to the earth. Experimental techniques for elucidating the scientific questions associated with the asteroids have been examined, and suitable experimental packages for the various missions are outlined. The guidance requirements for asteroid missions have been examined in some detail. Specific calculations on the guidance requirements for the target bodies considered have been made, and the results are tabulated. Author

N64-19570* IIT Research Inst., Chicago, Ill. Astro Sciences Center
THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: THE ASTEROIDS
D. L. Roberts 9 Mar. 1964 18 p refs
(NASA Contract NASr-65(06))
(NASA CR-53774; P-4; Formerly part of Rept. 1.4P2 No. 2, Sep. 1963) OTS: $1.60 ph

More than 1,500 separate asteroids of magnitude down to 18 have been detected and cataloged in the literature showing an average eccentricity of 0.15 and an average inclination of 10°. The origin of the asteroids is discussed in general terms, as is the connection between the asteroids and meteorites. The physical properties of the asteroids are given, but the limited amount of data that exists applies mainly to the four largest asteroids, Ceres, Pallas, Juno, and Vesta. Author

N64-19571* IIT Research Inst., Chicago, Ill. Astro Sciences Center
THE SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: INTERPLANETARY SPACE BEYOND 1 AU
D. L. Roberts 4 Feb. 1964 56 p refs
(NASA Contract NASr-65(06))
(NASA CR-53732; P-5) OTS: $5.60 ph

Aspects dealt with are the solar wind, the interplanetary magnetic field, cosmic rays, and the distribution of interplanetary matter. The primary concern has been to describe what is and what is not known about the interplanetary medium, and to point out what further information is urgently needed and can be obtained from space probes. R.L.K.

N64-19572* IIT Research Inst., Chicago, Ill. Astro Sciences Center
SUMMARY OF ONE WAY BALLISTIC TRAJECTORY DATA: EARTH TO SOLAR SYSTEM TARGETS
F. Narin and P. M. Pierce [1964] 67 p refs
(NASA Contract NASr-65(06))
(NASA CR-53730; Rept. T-4R) OTS: $6.60 ph

A survey of one-way ballistic trajectories (conic sections, impulsive thrusting, one gravitating body at a time) to major targets and positions within the solar system was made using the ASC/IITRI conic section trajectory system on the IBM-7090 computer. Comparison of energy requirements for flights to a wide variety of places within the solar system may be made using the survey. Curves are presented for ideal velocity (ΔV) and hyperbolic excess speed at the target (VHP) for flights to all the planets. Curves of ΔV for flights from earth to distances of 0.01 a.u. to 100 a.u. in the ecliptic plane are presented. Four curves are given for flights out of the ecliptic plane to distances of 0.3 to 5.0 a.u. from the sun. A curve is presented of the key parameters for minimum energy flights to all angles out of the ecliptic plane. Curves and tables of the velocity increments (DV) required to put approaching spacecraft into near planet orbits are presented for all the planets. Author

N64-19598* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD '63. A YEAR IN REVIEW AT GODDARD SPACE FLIGHT CENTER
Alfred Rosenthal [1963] 154 p
(NASA TM X-51626) OTS: $11.50 ph

Events of significance occurring at Goddard Space Flight Center, Greenbelt, Md., in 1963 are listed chronologically from January 1 through December 31. Included also are photographs of various meteorological and communications satellites, test patterns from both Relay and Syncom, reproductions of actual transmissions, and copies of addresses delivered by GSFC personnel on space exploration and tracking data and acquisition. A.W.

N64-19744 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NO GAINS WITHOUT PAINS, MARS I
Zdenek Dobrichovsky 20 Feb. 1963 7 p Transl. into ENGLISH from Véda Tech. Mládezi (Czech.), no. 26, 1962 p 915-917
(FTD-TT-63-131/1+2; AD-299855)

The methods by which the trajectory of the Mars I station is controlled are discussed. The radio-astronavigation system and the photo TV transmission (by which the station Mars I can photograph the surface of the planet Mars and, by means of TV transmission, relay the pictures to Earth) are described. R.T.K.

N64-19772 Mitre Corp., Bedford, Mass.
GENERAL ORBIT CHANGE OF AN EARTH SATELLITE BY A SINGLE IMPULSE
P. J. Plender Bedford, Mass., Electron. Systems Div., Dec. 1963 29 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-63-481; W-6369; AD-427158)

An analysis is presented of the mechanics and geometry of a general change in an earth satellite orbit caused by a single impulse. Typical numerical solutions of the resulting equations, carried out by a digital computer program, are given. Author

N64-19793* Sperry Gyroscope Co., Great Neck, N.Y.
PROGRAM MANUAL FOR OPERATIONAL MINIMUM VARIANCE TRACKING AND ORBIT PREDICTION PROGRAM
Jan. 1964 287 p refs
(NASA Contract NAS5-3509)
(NASA CR-53866; AB-1210-0022) OTS: $16.50 ph

Described is an operational version of a computing program for orbit determination as based on an extension of the Schmidt-Kalman minimum variance technique for processing tracking data. R.L.K.

N64-19861 Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.
FLIGHT DATA SYSTEM ORBITAL ERROR ANALYSIS Engineering Report
L. Cohen and S. P. Holzapfel Oct. 1963 85 p refs
(Contract AF 33(616)-6579)
(SMFD-2-1; AD-429033)

This report consists of the following system study reports on the flight data system: (1) The inertial computation requirement analysis includes the pseudocoordinate system for orbital flights, which describes the inertial requirements for suborbital vehicles, and the computation requirements for the flight data system, which details the iteration rates and word lengths required of the central digital computer. (2) The first-order orbital error analysis is predicated on a control system consisting of a high-speed digital computer and a four-gimbaled gyroscopically stabilized inertial platform mounting three orthogonally oriented accelerometers. The propagation of errors is considered from the end-of-boost, through the ascending coast phase, injection phase, a circular orbit phase, a retrofire phase, and a descending coast phase. (3) The analysis of second-order gravitational effects investigates the effect of gravitational anomalies, due to oblateness and nonhomogeneity, upon satellite polar orbits. Author

N64-19866 Mitre Corp., Bedford, Mass.
POSITION AND VELOCITY ERRORS RESULTING FROM IMPERFECT ESTIMATION OF NEARLY CIRCULAR SATELLITE ORBITS
R. Manasse Bedford, Mass., Electronic Systems Div., Jan. 1964 14 p refs
(Contract AF 19(628)-2390)
(W-6637; ESD-TDR-64-77; AD-428812)

An error analysis is presented for the problem of prediction of position and velocity of a satellite with a nearly circular orbit from initial measurements of position and velocity. Relatively simple expressions are obtained for these errors, which should prove useful both for obtaining numerical results and for the physical interpretation of the effect of errors on prediction. The error formulas are in agreement with results obtained earlier by Schweppe using a more general method of analysis. Author

N64-19870 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADAR OBSERVATIONS OF THE MOON AT 8.6-mm WAVELENGTH Technical Report No. 331
V. L. Lynn, M. D. Sohigian, and E. A. Crocker 8 Oct. 1963 28 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-582; AD-426207)

The experimental, pseudo-CW radar used to detect the first lunar echoes at millimeter wavelengths is described. This system, with a peak-power output of 12 w, was used to obtain preliminary mapping of the moon at a wavelength of 8.6 mm with resolution in angle only. Approximately 85% of the reflected power can be attributed to diffuse scattering. This component appears to follow the Lommel-Seeliger Law although there are insufficient data to define the distribution accurately. For the positions observed, there was no significant difference in reflection between the maria and the continents, within limits of approximately ± 2 db. The total radar cross section of the moon at 8.6-mm wavelength was determined to be 7% ± 2 of the geometric cross section. Author

N64-19879* California U., Berkeley Space Sciences Lab.
INTERPRETATION OF THE 3- TO 4-MICRON INFRARED SPECTRUM OF MARS
D. G. Rea, T. Belsky, and M. Calvin Repr. from Science, v. 141, no. 3584, 6 Sep. 1963 p 923–927 refs
(NASA Grant NsG-101-61)

Infrared reflection spectra were recorded for a large number of inorganic and organic samples to interpret the 3μ to 4μ spectrum of Mars. Martian reflection spectra obtained by Sinton favored the conclusion that carbohydrates were present because the spectra closely resembled those of organic molecules. Colthup did not interpret the bands in the same manner; the great difference between absorption and reflection spectra makes widely varied interpretation possible. The most minute investigation of the spectra cannot give definite answers at this time. G.D.B.

N64-19897* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CONSTANTS AND RELATED DATA FOR USE IN TRAJECTORY CALCULATIONS AS ADOPTED BY THE AD HOC NASA STANDARD CONSTANTS COMMITTEE
Victor C. Clarke, Jr. 6 Mar. 1964 38 p refs
(NASA Contract NAS7-100)
(NASA CR-53921; JPL-TR-32-604) OTS: $3.60 ph

A discussion is presented of the establishment of a standard set of constants and ephemeris data for trajectory and orbit calculations to insure NASA and NASA agencies a degree of accuracy and consistency in their computations. The report contains: (1) earth constants; (2) lunar constants; (3) planetary constants; and (4) lunar and planetary ephemerides. A.L.B.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-19365* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROGRESS ON THE LAUNCH-VEHICLE BUFFETING PROBLEM
A. Gerald Rainey *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 163–177 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

Buffeting pressures are dimensionally well behaved in that results obtained on wind-tunnel models, in most cases, can be scaled by reduced-frequency concepts to full-scale conditions. A few measurements of space–time correlation characteristics for separated flows indicate a picture of convected, decaying patterns of pressure somewhat similar to that which has been found for attached boundary layers and jet noise. The state-of-the-art in techniques for predicting structural response to this aerodynamic environment is indicated to be only fair. High-frequency response of structural components, such as interstage adapters, involves the effects of multiple random inputs on structures with complicated dynamic characteristics. Several active research programs aimed at developing techniques for handling this problem are discussed. Also discussed are methods for treating the low-frequency gross-bending-response problem. Author

N64-19366* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME SOURCES OF GROUND-WIND LOADS IN LAUNCH VEHICLES
Donald A. Buell *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 178–183 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

Test results obtained on models in a steady wind are presented to indicate potential sources of oscillations induced by ground winds in launch vehicles. The following caused large oscillations: single conduits, an umbilical tower, and blunt noses. It was indicated that model motion and roughness accentuate the wind excitation in certain cases. Author

N64-19373* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DYNAMIC PROBLEMS IN LAUNCH VEHICLES AND SPACECRAFT
Robert M. Hunt and Francis C. Hung (North Am. Aviation) *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 461–470 refs (See N64-19359 12-01) $7.50 members, $15.00 nonmembers

A brief discussion is presented of the dynamic problems in launch vehicles and spacecraft that affect reliability. Some of the problems discussed are: (1) crawler-transport-vehicle dynamics; (2) ground wind during prelaunch and launch; (3)

vehicle response to acoustic environment; (4) thrust-buildup structural transient; (5) acoustic and buffeting environment in flight; (6) vapor-liquid and bulkhead interaction during engine-cutoff transient; (7) separation of stages or shrouds (jettisoning); (8) dynamics of fluids under low-g environment; and (9) lunar-landing structural dynamics. P.V.E.

N64-19655 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamics Lab.
OPTIMIZATION TECHNIQUES – A COMPARISON
L. Schwartz Mar. 1964 32 p refs
(FDL-TDR-64-21; AD-437895)

A single-axis satellite attitude control system is used as an example for the application of several optimization techniques. The vehicle and actuator dynamics are linear, and the performance criterion is quadratic (related to minimum-energy control). The techniques used are the classical calculus of variations, the maximum principle, dynamic programing, and steepest descent. Author

N64-19664 Aerospace Corp., El Segundo, Calif. Electronics Div.
DERIVATION OF THE GUIDANCE EQUATIONS FOR THE USAF ATHENA
L. K. Herman, R. M. Allman, and B. Katz 30 Mar. 1964 41 p refs
(Contract AF 04(695)-269)
(BSD-TDR-64-37; TDR-269(4810-31)-1; AD-437525)

The USAF Athena is a reentry test vehicle with four solid-propellant stages. A midcourse-correction guidance is used to compensate for boost dispersions by adjusting the third stage attitude and ignition time. The guidance computations are performed in a ground-based digital computer using radar obtained after second-stage burnout. Because this is a reentry test vehicle, the guidance system must cause the payload to meet various reentry constraints as well as the usual impact point constraint. The complete derivation of the guidance equations and a description of the entire guidance loop are presented. Author

N64-19707* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE USE OF A MAGNETOMETER TO DETERMINE TO ANGULAR MOTION OF A SPINNING BODY IN REGULAR PRECESSION
George R. Young and Jesse D. Timmons Washington, NASA, May 1964 22 p refs
(NASA TN D-2284) OTS: $0.50

A spinning body is assumed to precess at a constant rate in a stationary cone about its angular-momentum vector. Curves are presented that represent the component of the earth's local-magnetic-field vector as measured by a magnetometer mounted rigidly in a spinning body. The curves are analyzed to determine the body-coning angle and the angle between the earth's local magnetic vector and the angular-momentum vector of the body. Author

N64-19708 Sandia Corp., Albuquerque, N. Mex.
SNAP-10A SAFETY FLIGHT-TEST PLAN (FINAL). RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1)
C. E. Erickson, J. I. Hegge, J. Jacobs, R. D. Klett, H. R. Spahr et al Mar. 1964 69 p refs
(SC-RR-64-501)

This report constitutes the RFD-1 Safety Flight Plan for investigating the disassembly, destruction, and disposal of the SNAP-10A reactor during reentry. The reentry test vehicle on which the inert reactor is mounted will be placed in the reentry trajectory by a NASA Scout launched from Wallops Island, Virginia. Launched at 90° elevation along a 129° heading, the Scout trajectory will be programed to guide the test vehicle into a flight path passing near Bermuda at 150,000-ft altitude, with impact occurring approximately 150 miles south of Bermuda. Telemetry, optical, and radar coverage will be used to gather data describing the behavior of the test vehicle and the SNAP-10A reactor during reentry into the atmosphere from 400,000-ft altitude. Author

N64-19743 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE RETURN ON ARTIFICIAL STATELLITES TO EARTH
V. Borisov 1 Mar. 1963 5 p Transl. into ENGLISH from Sov. Aviatsiya, (Moscow), 5 Apr. 1958 p 4
(FTD-TT-63-55/1+2; AD-299663)

Problems are discussed relative to the dangers of reentry of artificial satellites to earth. Possible solutions suggested are the use of atmosphere for braking, configuration changes of satellites while in flight, application of protective coatings and the use of circulatory, porous or evaporative cooling, and greater use of magnetoaerodynamics. A.W.

N64-19754 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FROM THE FIRST SATELLITE TO GROUP FLIGHT
A. A. Blagonravov 31 Dec. 1963 9 p Transl. into ENGLISH from Sov. Latv. (Riga), 4 Oct. 1962 p 2
(FTD-TT-63-1081/1; AD-433533)

This is a general Soviet report of the 5-year space accomplishments of the Soviet Union from October 4, 1957, to October 4, 1962. A.W.

N64-19878* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN, TESTS, AND ANALYSIS OF A HOT STRUCTURE FOR LIFTING REENTRY VEHICLES
Richard A. Pride, Dick M. Royster, and Bobbie F. Helms Washington, NASA, Apr. 1964 152 p
(NASA TN D-2186) OTS: $2.75

A large structural model of a lifting reentry vehicle has been designed and fabricated to incorporate design concepts applicable to a radiation-cooled vehicle. Thermal-stress-alleviating features of the model are discussed. The structure successfully survived all environmental tests, which included approximately 100 cycles of room-temperature loading and 33 cycles of combined loading and heating up to temperatures of 1,600° F. Measured temperatures are presented for all parts of the model for tests at 1,600° F. Comparisons made between measured and calculated strains and deflections for the model show satisfactory agreement. Environmental tests on model components include corrugation-stiffened skin panels subjected to various combinations of heat, load, random intense noise, and wind-tunnel flutter; corrugated shear webs were subjected to combined heat and load. Tests were generally carried to failure. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

No abstracts in this issue.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-19309* Stanford U., Calif. Stanford Electronics Labs.
ALOUETTE TOPSIDE SOUNDINGS MONITORED AT STANFORD UNIVERSITY Technical Report No. 6
J. O. Thomas and A. Y. Sader Dec. 1963 95 p refs
(NASA Grant NsG-30-60)
(NASA CR-53820; SEL-64-007) OTS: $8.60 ph

Alouette topside soundings have been used to determine the diurnal, seasonal, and latitudinal variations of electron density at the orbit of the satellite over a wide range of latitudes. The necessary data manipulations and calculations were carried out in a digital computer program that is described briefly. Examples of topside ionograms observed under a wide variety of conditions are presented, and their main features are described. Author

N64-19316* Aeronutronic, Newport Beach, Calif.
LUNAR ROUGH LANDING CAPSULE DEVELOPMENT PROGRAM Final Technical Report
20 Feb. 1963 249 p refs
(NASA Contract NAS7-100; JPL Contract N-21453)
(NASA CR-53814; U-2007) OTS: $16.00 ph

A lunar capsule system was developed as part of the Ranger Program for an extended seismometer experiment. The result is a qualified lunar-landing delivery system, able to deliver a 92-pound sphere with impact speeds of less than 200 ft/sec. An omnidirectional impact-limiter system absorbs the impact energy and limits payload accelerations to less than 3000 g. The seismometer-experiment payload will survive the impact acceleration and operate for an extended period of time in the hostile lunar environment. Processing and assembly techniques achieve biological sterility in a complex space payload. A facsimile picture-taking device, compatible with the payload constraints of the Ranger capsule system, was shown to be feasible. R.L.K.

N64-19319 International Geophysical Year World Data Center A, Washington, D.C.
ROCKETS AND SATELLITES. CATALOGUE OF DATA IN WORLD DATA CENTER A, 1 JANUARY 1962-31 DECEMBER 1963
Jan. 1964 90 p refs 2d compilation of data submitted to COSPAR

Listed are data on sounding rockets launched by Australia, Japan, Sweden, the Soviet Union, the United Kingdom, and the United States, and data on artificial earth satellites and space probes launched and/or observed over the 2-year period. A bibliography of reports and reprints, listed by author and by subject, is included. R.L.K.

N64-19350* Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOG OF PRECISELY REDUCED OBSERVATIONS
Phyllis Stern, comp. 27 Feb. 1964 297 p refs
(NASA Grant NsG-87-60)
(NASA CR-53783; SAO Special Rept. 147; P-11) OTS: $18.50 ph

A listing of the positions of artificial satellites as obtained from the precise reduction of the films taken at 12 Baker–Nunn camera stations is presented. The catalog presented observations of the following from July 1 through Dec 31, 1962: (1) satellite 1959 α 1 (Vanguard II); (2) satellite 1959 η 1 (Vanguard III); (3) satellite 1960 ι 2 (Echo I rocket body); (4) satellite 1961 δ 1 (Explorer IX). Also included are observations for satellite 1961 α δ 1 (Midas 4) from March 9 through Dec. 31, 1962. The information presented includes the following: (1) year, month, and day of observation; (2) time of observation; (3) topocentric right ascension expressed in hours, minutes, and seconds of time; (4) topocentric declination in degrees, minutes, and seconds of arc; and (5) number and name of Baker–Nunn station. P.V.E.

N64-19450* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIKE CAJUN SOUNDING ROCKET PERFORMANCE
John H. Lane and Nancy L. Kemmerer Apr. 1962 42 p
(NASA TM X-51614; X-616-62-66) OTS: $4.60 ph

Accurate predictions of Nike-Cajun performance have increased as a result of (1) completion of trajectory studies; (2) analyses of Nike-Cajun radar data and comparison of theoretical and actual performance; and (3) preparation of curves for predicting performance. Because Nike-Cajun performance is highly sensitive to variations in Cajun drag, calculations were run with "low," "medium," and "high" drag coefficient inputs. All data are presented in 23 figures and 5 tables. A.W.

N64-19595* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-26, VOLUME VI FOR THE PERIOD JANUARY 1, 1964 TO FEBRUARY 29, 1964. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Mar. 1964 83 p refs
(NASA Contract NAS7-100)
(NASA CR-53834; JPL-SPS-37-26, Vol. 6) OTS: $8.10 ph

This report presents summaries of the following Jet Propulsion Laboratory programs and projects: (1) Ranger; (2) Surveyor; (3) Mariner; (4) the Deep Space Instrumentation Facility; (5) operational and test facilities; and (6) space-instruments development. A.W.

N64-19599* National Aeronautics and Space Administration. Goddard Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOL. 4, NO. 6
1 Apr. 1964 12 p
(NASA TM X-51624; X-533-63-1) OTS: $1.60 ph

This report reflects data computed and compiled by Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory as of 1200Z on April 1, 1964, and includes the following under the general heading "Objects in Orbit": code name, source (U.S., U.S.S.R.), launch, nodal period, inclination, apogee km, perigee km, and transmitting frequency (mc/s). A.W.

N64-19618* Radiation, Inc., Melbourne, Fla.
REFLECTIVITY CHARACTERISTICS OF ECHO BALLOONS Final Report
Oct. 1962 66 p ref
(NASA Contract NAS5-890)
(NASA CR-53827) OTS: $6.60 ph

Scale-model techniques were used to measure the bistatic response to the Echo I and II balloons, with the primary effort being devoted to Echo II. Test frequencies of 3,000 and 9,600 mc/s simulate data at 55.5, 178, and 890 mc/s. Measurements were made using vertical and horizontal polarizations for several bistatic angles and three model orientations. The results of the measurements indicate that, in general, the Echo II balloon is a good bistatic reflector at the frequencies simulated. Monostatic and bistatic measurements were made on the Dodecahedron balloon at 9,600 mc/s. The results indicate a high degree of scintillation and a large variation of median radar cross section for both monostatic and bistatic measurements; the Dodecahedron did not increase the average radar cross section over the response of a comparable sphere. Preliminary efforts on a spherical cap-type reflector, for the purpose of determining the feasibility of using a segment of a sphere to simulate the whole sphere, indicate that any conducting structure behind the cap can be expected to change the response of the cap. The possibility exists of dimensioning the cap to provide a response greater than that possible using a sphere of the same radius, if proper stabilization could be provided and the frequency band is restricted. R.L.K.

N64-19777* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NO. 7
15 Apr. 1964 12 p
(NASA TM X-51616; X-533-63-1) OTS: $1.60 ph

Data are computed and compiled by the Goddard Space Flight Center, Norad, and the Smithsonian Astrophysical Observatory as of 1200Z on April 15, 1964. R.L.K.

N64-19971 IIT Communication Systems, Inc., Paramus, N.J.
PARAMETRIC ANALYSIS OF MEDIUM-ALTITUDE ACTIVE AND PASSIVE COMMUNICATION SATELLITES
20 Sep. 1963 211 p refs Prepared by General Electric Co., Syracuse, N.Y.
(Contract AF 19(626)-5)
(ICS-63-TR-250; ESD-TDR-63-677; AD-428311)

Medium-altitude active and passive satellite-communication systems are compared technically and economically for use in a military communications network. Factors considered are current technology, operational complexity, and information-transfer capability. Active and passive satellite models, representative of the current state-of-the-art, are defined, and simple mathematical models provide weight and cost variations for the models as a function of satellite capabilities. Satellite performance, orbital altitude, and inclination angle are allowed to vary. It appears that networks having a small number of ground stations favor passive systems. As the number of ground stations is increased, active systems are likely to be more advantageous. Small satellites seem to be favored for both active and passive systems. R.L.K.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-19368* National Aeronautics and Space Administration. Langley Research Center, Langley, Va.
SOME RECENT DEVELOPMENTS IN FLUTTER OF FLAT PANELS
Herman L. Bohon and Sidney C. Dixon *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 269–281 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

The accuracy and range of validity of flutter analysis of isotropic panels using the two-dimensional static aerodynamic approximation are investigated by comparison with results obtained on the basis of exact linearized three-dimensional potential-flow theory. For unstressed panels these results indicate that for Mach number $M \geq 1.3$, two-dimensional static aerodynamics is applicable over the whole range of length–width ratios greater than one. It is also demonstrated that the agreement between theory and experiment is good when the data are obtained from panels representative of the idealized conditions of theory. For stressed panels, inclusion of structural damping improves the correlation of theory and experiment. Other factors such as differential pressure and initial imperfections must also be considered in order to further improve the correlation. In addition, flutter of corrugation-stiffened panels is considered. Experimental results for unstressed panels are compared with numerical results based on two-dimensional static aerodynamics for panels simply supported on all edges. Author

N64-19369* Case Inst. of Tech., Cleveland, Ohio
AN INTEGRATED APPROACH TO STRUCTURAL SYNTHESIS AND ANALYSIS
Lucien A. Schmit, Jr. and Richard L. Fox *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 294–315 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers
(NASA Grant NsG-110-61)

The structural synthesis problem, which is currently viewed as an inequality constrained minimization problem in design variable space, is transformed into an unconstrained minimization problem in a space such that each point represents a set of values for the design variables as well as for each behavior variable in each load condition. Using penalty functions and a trial value of the optimum weight (W_0), rather than slack variables and Lagrange multipliers, a positive function ψ is constructed such that any point where $\psi = 0$ represents an acceptable design of weight W_0 or less. This integrated formulation is used to seek optimum designs by systematically reducing W_0, thus generating a sequence of acceptable designs with decreasing weight. An integrated synthesis formulation of a general space truss problem is outlined. Numerical examples of optimum designs based on a nonlinear analysis for a one node m bar planar truss are presented, together with computer running times. Author

N64-19408 Lessells and Associates, Inc., Waltham, Mass.
PRELIMINARY ANALYSIS OF BENDING-MOMENT DATA FROM SHIPS AT SEA Second Progress Report
D.J. Fritch, F.C. Bailey, and N.S. Wise Washington, Commerce Dept., 27 Dec. 1963 41 p refs
(Contract NObs-77139)
(PB-181557; SSC-153; AD-436877) OTS: $1.25

Data playback, manual reduction and analysis techniques, and the automatic system for future analysis are presented. Examples are given of some forms of presentation of long-term trends. Useful data were obtained on 85% of voyages representing three ship-years of operation of a C-4 dry-cargo vessel on North Atlantic trade routes. Two complete voyages were analyzed using manual techniques, and the results of this analysis are presented. The maximum observed peak-to-peak variation of wave-induced stress was 8,300 psi occurring during a Beaufort 11 to 12 Sea. A prediction based on the limited amount of long-term data available from the two analyzed voyages yielded an extreme value of 10,290 psi for a year of operation of this type of ship on North Atlantic route. Stress variations on the order of 9,000 psi have been observed during the dry docking of the two instrumented ships. Author

N64-19543 Sud-Aviation, Paris (France) Central Lab.
FATIGUE BEHAVIOR AND CRACK PROPAGATION OF [THE ALLOY] A.U2GN AS A FUNCTION OF TEMPERATURE AND FREQUENCY [TENUE EN FATIGUE ET PROPAGATION DES CRIQUES DE L'A.U2GN EN FONCTION DE LA TEMPERATURE ET DE LA FREQUENCE]
R. La Chenaud [1963] 41 p refs In FRENCH Presented at ICAF-AGARD Conf., Rome, 22–26 Apr. 1963
(ICAF-231)

This report shows that, at the classic frequency of 2,000 cycles/minute, other things being equal, fatigue behavior of the alloy A.U2GN is the same within a temperature range of 20° to 175° C. Rate of crack propagation is twice as high at 20 cycles/hour than at 2,000 cycles/minute and, at 2,000 cycles/minute, this rate is twice as weak at 150° than at 20° C of temperature. A.W.

N64-19564 Forest Products Lab., Madison, Wis.
EDGEWISE COMPRESSIVE BUCKLING OF FLAT SANDWICH PANELS: LOADED ENDS SIMPLY SUPPORTED AND SIDES SUPPORTED BY BEAMS
John J. Zahn and Shun Cheng Feb. 1964 35 p refs
(BuWEPS Order 19-64-8004-WEPS; Contract AF 33(657)63-358)
(FPL-019; AD-432258)

Flat sandwich panels with equal isotropic facings and orthotropic or isotropic cores, under edge compression, were analyzed. The loaded panel ends are assumed to be simply supported and the sides are hinged to simple beams that carry end load. Curves of buckling coefficients are presented for a sandwich with isotropic core. Author

N64-19619* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
INVESTIGATION OF STRUCTURAL PROPERTIES OF FIBER GLASS FILAMENT-WOUND PRESSURE VESSELS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 3, 1 Jan.-31 Mar. 1964
J. M. Toth, Jr. Apr. 1964 74 p refs
(NASA Contract NAS3-2562)
(NASA CR-53826; SM-45893) OTS: $7.60 ph

Progress was reported in the following areas: (1) Liner evaluations were continued by liquid hydrogen testing with the 7 1/2-in.-diam biaxial specimen. (2) On the basis of the results to date, the metals appear to show the most promise as integrally bonded liners. Due to its excellent cyclic behavior at 36% of ultimate(−423° F), favorable differential contraction characteristics, and satisfactory deposition process, electrodeposited nickel will be used as the liner for the 18-in.-diam pressure vessels. (3) Initial design of the 18-in.-diam pressure vessels has been completed. (4) Fabrication, testing, and quality control procedures have been completed for the 18-in.-diam vessels. Author

N64-19722* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUTTER OF CURVED AND FLAT SANDWICH PANELS SUBJECTED TO SUPERSONIC FLOW
John A. Mc Elman Washington, NASA, Apr. 1964 16 p refs (NASA TN D-2192) OTS: $0.50

A small-deflection theory is used in conjunction with a Galerkin technique to determine the flutter characteristics of simply supported sandwich panels, both flat and slightly curved. The sandwich cover plates are assumed to be of the same material and thickness, and the core material is assumed isotropic. The flow is assumed supersonic over one surface, and static aerodynamic strip theory is used to describe the aerodynamic loading. A two-mode solutuion is used to illustrate the effects of curvature, core-transverse shear stiffness, and midplane loads. It is found that the effects of curvature can be separated from the core stiffness effects. Author

N64-19725* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL FLUTTER RESULTS FOR CORRUGATION-STIFFENED PANELS AT A MACH NUMBER OF 3
Herman L. Bohon Washington, NASA, May 1964 22 p refs (NASA TN D-2293) OTS: $0.50

Results are presented for panels having two different corrugation shapes. The panels were tested under aerodynamic heating conditions in the Langley 9- by 6-ft thermal structures tunnel at a Mach number of 3 for values of the dynamic pressure ranging from 1,500 to 5,000 psf and for stagnation temperatures ranging from 350° to 625° F. The experimental results are compared with theory and with results from an isotropic panel obtained under similar test conditions. Author

N64-19733 Lehigh U., Bethlehem, Pa.
GEOMETRIC EFFECTS OF PLATE THICKNESS First Progress Report
R. D. Stout, C. R. Roper, and D. A. Magee Washington, NAS-NRC, 7 Feb. 1964 29 p refs
(Contract NObs-84829)
(SSC-160; AD-430686)

Three testing methods were examined in order to provide a variety of loading conditions in measuring the resistance to brittle fracture of ship steel in heavy sections. The van der Veen test, the Bagsar test, and the drop-weight test showed general agreement in their response to changes in plate thickness ranging from 3/4 to 3 inches. The dimensional effect of plate thickness, with metallurgical variables held constant, was to raise the transition temperature markedly as the plate thickness was increased from 1/2 to 1 1/2 inches. Above 2 inches, thickness appeared to have much less effect on the transition temperature observed in these sharply notched specimens. The ABS Class C and "T-1" steels behaved similarly in this respect. In the presence of a severe notch, specimen widths and heights of 2 inches or greater appear adequate for testing purposes. R.L.K.

N64-19778* Southwest Research Inst., San Antonio, Tex.
LARGE AMPLITUDE FLEXURAL VIBRATION OF RECTANGULAR PLATES
Thein Wah Repr. from Int. J. Mech. Sci. (London), v. 5, 1963 p 425–438
(NASA Contract NASr-94(05))

By using an approximate formulation due to Berger, it is shown that the vibration of rectangular plates with amplitudes

may be treated in a simple and unified manner. Numerical results are given for various boundary conditions. Author

N64-19882* General Electric Co., Philadelphia, Pa.
MECHANICAL PROPERTIES OF FIBROUS COMPOSITES
B. Walter Rosen, Norris F. Dow and Zvi Hashin Washington, NASA, Apr. 1964 155 p refs
(NASA Contract NASw-470)
(NASA CR-31) OTS: $3.00

Relationships between the properties of fibrous composites and the properties of their constituents are evaluated. Bounds and expressions for the effective elastic moduli of materials reinforced by hollow circular fibers are derived by a variational method. Exact results are obtained for hexagonal arrays of identical fibers and approximate results for random arrays of fibers, which may have unequal cross sections. Typical numerical results are obtained for technically important elastic moduli. The tensile strength of composite materials consisting of a ductile matrix uniaxially reinforced by high-strength, high-stiffness fibers is analyzed. The fibers are treated as having a statistical distribution of imperfections that result in fiber failure under applied stress. The statistical accumulation of such flaws results in failure of the composite. The application of the analysis is demonstrated by using glass-fiber-strength data in an evaluation of glass-fiber-reinforced composites. Author

N64-19883* National Aeronautics and Space Administration, Washington, D.C.
GENERAL THEORY OF SHELLS AND ITS APPLICATIONS IN ENGINEERING
V. Z. Vlasov Apr. 1964 925 p refs Transl. into ENGLISH of "Obshchaya teoriya obolochek i yeye prilozheniya v tekhnike" Moscow, Gos. Izd. Tekh. Teor. Lit., 1949
(NASA TT F-99) OTS: $7.00

This book contains: (1) the complete theory of momentless shells with methods for calculation carried through to practical application; (2) the general moment theory of shells; (3) the general engineering moment theory and methods for calculating shallow shells; (4) the theory and methods for calculating orthotropic shells of medium length; (5) the general theory of thin-walled, three-dimensional systems constructed on a synthesis of methods of the construction mechanics of rod systems and the mathematical theory of elasticity. The theory makes it possible to solve a series of important practical problems connected with thin-walled structures used in different fields of construction engineering (building construction, aviation, machine building). Author

N64-19913 Advisory Group for Aeronautical Research and Development, Paris (France)
RECENT PANEL FLUTTER RESEARCH AND APPLICATIONS
Michael H. Shirk and James J. Olsen (AFSC) Sep. 1963 40 p refs
(AGARD-475)

This report presents the results that have been recently obtained from USAF research investigations of the flutter characteristics of panel and shell structures. A brief review is presented of the available literature on curved panels and shells and is followed by an extensive presentation of hitherto unpublished data from current programs. The results are interpreted in terms of their application to future systems and are followed by a section on conclusions and recommendations. Author

N64-19979 Illinois U., Urbana Engineering Experiment Station
CREEP OF CIRCULAR-SECTION TORSION-TENSION MEMBERS SUBJECTED TO NONPROPORTIONATE LOAD CHANGES Technical Report No. 6
N. Patnaik and O. M. Sidebottom Aug. 1963 34 p refs
(*Its* Bull., v. 61, no. 2) Available from Ill. U. Eng. Publ. Office: $2.00

An investigation undertaken to develop and verify a theoretical method for predicting deformations of a torsion–tension member of circular cross section subjected to nonproportionate load changes is discussed. The method that is proposed as a result of the investigation makes use of a closed solution creep theory for torsion–tension members subjected to constant loads. Some of the conclusions reached during the investigation are the following: (1) Constant-stress isochronous stress–strain data for high-density polyethylene are accurately approximated by an arc hyperbolic sine function. (2) For incremental loading tests in tension or compression at initial stresses up to 800 psi and increments up to 30 percent of the initial stress, strain increments for high density polyethylene can be obtained for any time after a load increment from an isochronous stress–strain curve that can be represented by the same arc hyperbolic sine function. (3) It is possible to compute deformations for one or more load changes by using constant stress creep data alone, provided no unloading occurs. P.V.E.

N64-19982* Lehigh U., Bethlehem, Pa. Inst. of Research
A DISCUSSION OF "RANDOM FATIGUE FAILURE OF A MULTIPLE LOAD PATH REDUNDANT STRUCTURE"
James R. Rice and Earl J. Brown [1964] 10 p ref Presented at the Sagamore Conf., Aug. 1963 Submitted for Publication
(NASA Grant NsG-410)
(NASA CR-53506) OTS: $1.10 ph

A number of assumptions were made in formulating the basic equations for the randomly loaded, statistically variant, single structural element. These assumptions are interpreted in terms of fatigue crack propagation. The fundamentals of a statistical fatigue theory based on crack propagation are formulated. Some extensions of the theory, which might result in the solution of important fatigue problems, are indicated.
P.V.E.

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-19360 United Aircraft Corp., Farmington, Conn. Systems Center
A PARAMETRIC STUDY CONCERNING THE STRUCTURAL FACTOR OF SAFETY FOR AEROSPACE VEHICLES
H. E. Kurschner and E. R. Bruun *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 38–57 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers

A discussion is presented of an investigation to obtain a better understanding, by numerical demonstration, of the effects of the factor of safety, as well as of the various philosophies that utilize a factor of safety, on pertinent structural parameters, and to correlate these effects to structural reliability and vehicle performance. Three variations on the current factor-of-safety philosophy were investigated: (1) factor-of-safety method (ultimate design); (2) yield philosophy; and

(3) modified factor-of-safety methods. Also, structural-design criteria, based on a reliability approach by considering the statistical distribution of certain basic design factors, were developed. The results obtained led to the conclusion that a more rational approach to structural design criteria than the factor-of-safety method would result in a lighter structure having improved vehicle performance without jeopardizing the structural reliability. P.V.E.

N64-19370* Goodyear Aerospace Corp., Akron, Ohio
METHODS OF EVALUATION OF INFLATABLE STRUCTURES FOR SPACE APPLICATIONS
W. N. Brewer and N. L. Jeppesen *In* AIAA 5th Ann. Structures and Mater. Conf. 1964 p 344–360 refs (See N64-19359 12-01) AIAA: $7.50 members, $15.00 nonmembers
(NASA Contract NASw-471)

This paper provides some insight into the most significant parameters that constitute the weight of various inflatable space structures and offers a means of estimating their structural weight. Structural weights for typical inflatable space structures of different shapes and constructed of different materials were calculated for the purpose of evaluating the structural efficiency of each configuration. The structural efficiency of each configuration was evaluated by the use of the figure of merit. The figure of merit can range from about 400,000 in. for an extremely efficient structure to 4000 in. for a very inefficient structure. Knowing this range, it is possible to establish the relative efficiency of any pressurized structure or to make a quick comparison of alternate designs. Author

N64-19413 Aerojet-General Corp., Sacramento, Calif.
INVESTIGATION OF FILAMENT WINDING PATTERNS Fifth Bimonthly Report, 24 Dec. 1963-24 Feb. 1964
27 Mar. 1964 12 p
(Contract NOw-63-0627-C(FBM))
(Rept. 0627-I-5; AD-436438)

Described is progress in a program conducted to increase the understanding of the interrelation between chamber-winding patterns and chamber behavior. All of the 10 units originally included in Phase I of this program were hydrostatically tested and the data were analyzed. The design of the deformation-control-evaluation chamber for Phase II of the program was initiated on the basis of a developed orthotropic analytical approach modified to reflect the changes that occur in orthotropic properties with load. Author

N64-19565 Forest Products Lab., Madison, Wis.
INVESTIGATION OF METHODS FOR EVALUATING UNWOVEN GLASS-FIBER-REINFORCED PLASTIC LAMINATES IN FLEXURE
Karl Romstad Feb. 1964 40 p refs
(BuWEPS Order 19-64-8004-WEPS; Contract AF 33(657)63-358)
(FPL-024; AD-432311)

Three plastic laminates reinforced with unwoven, unidirectional glass fibers were evaluated to improve flexure test procedures for these materials. Also investigated were the effects of radius of loading nose, length of overhang, and different two-point loading systems on properties of 1/8-in. laminates. Evaluation results concluded that present test methods for reinforced plastics often result in failures that do not accurately evaluate the outer fiber strength of the material. Consequently, modulus of rupture values are lower than would be expected if true outer fiber failures had occurred. Horizontal shear failures can be eliminated by using a specimen with a span-depth ratio greater than 16. For a long specimen, a correction factor must be applied to the conventional moment expression to include the effect of horizontal components of force at the reaction supports. Compression failures beneath the load points were eliminated by using a 0.01-in.-thick metal plate beneath a loading nose of 1/8-inch radius, by increasing the loading nose radius, or by increasing the specimen span-depth ratio. Author

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